Charting Our Own Course:

Today's Challenges, Tomorrow's Opportunities

The Office of Energy Independence

Energy Independence Plan

December 2008

Energy Information Report

In its 2007 session, the 82nd Iowa General Assembly passed, and Governor Culver signed into law, extensive and far-reaching new state energy policy legislation. Included was a directive to the Department of Natural Resources (DNR) to deliver to the Director of the new Office of Energy Independence a report on six broad topics regarding Iowa's energy resources. In particular, House File 918 amends Iowa Code 473.7(1) so that the DNR is to report on:

A. The historical use and distribution of energy in Iowa.

B. The growth rate of energy consumption in Iowa, including rates of growth for each energy source.

C. A projection of Iowa's energy needs at a minimum through the year 2025.

D. The impact of meeting Iowa's energy needs on the economy of the state, including the impact of energy efficiency and renewable energy on employment and economic development.

E. The impact of meeting Iowa's energy needs on the environment of the state, including the impact of energy production and use on greenhouse gas emissions.

F. An evaluation of renewable energy sources, including the current and future technological potential for such sources.

Much of the energy information for this report has been derived from the on-line resources of the Energy Information Administration (EIA) of the United States Department of Energy. The EIA provides policy-independent data, forecasts, and analyses on energy production, stored supplies, consumption, and prices. For complete, economy-wide information, the most recent data available from EIA is for 2006. For some energy sectors more current data is available from EIA and other sources, and that information has been included in this report.

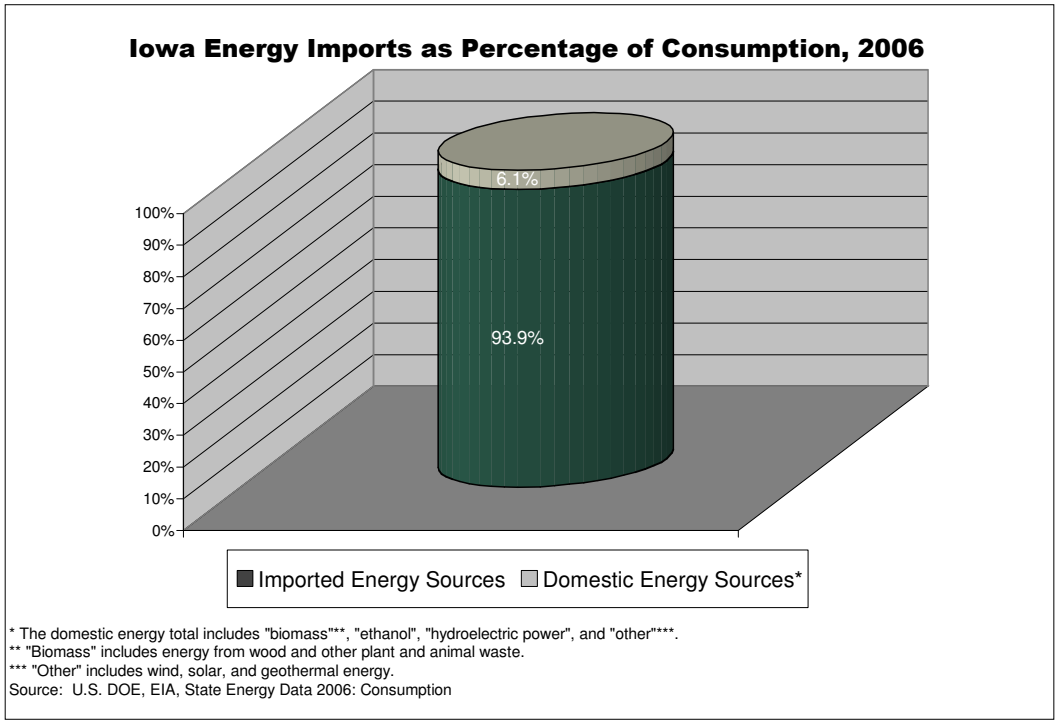
A. Historical use and distribution of energy in Iowa.

Imported Energy and Energy Balance

Iowa continues to rely heavily on energy imported from other states and nations. The major imported energy sources in Iowa include petroleum, coal, natural gas and uranium for electricity production. EIA data from 2006, indicated in Graph 1 below, shows that 93.9% of Iowa's energy consumption comprised of imported resources.

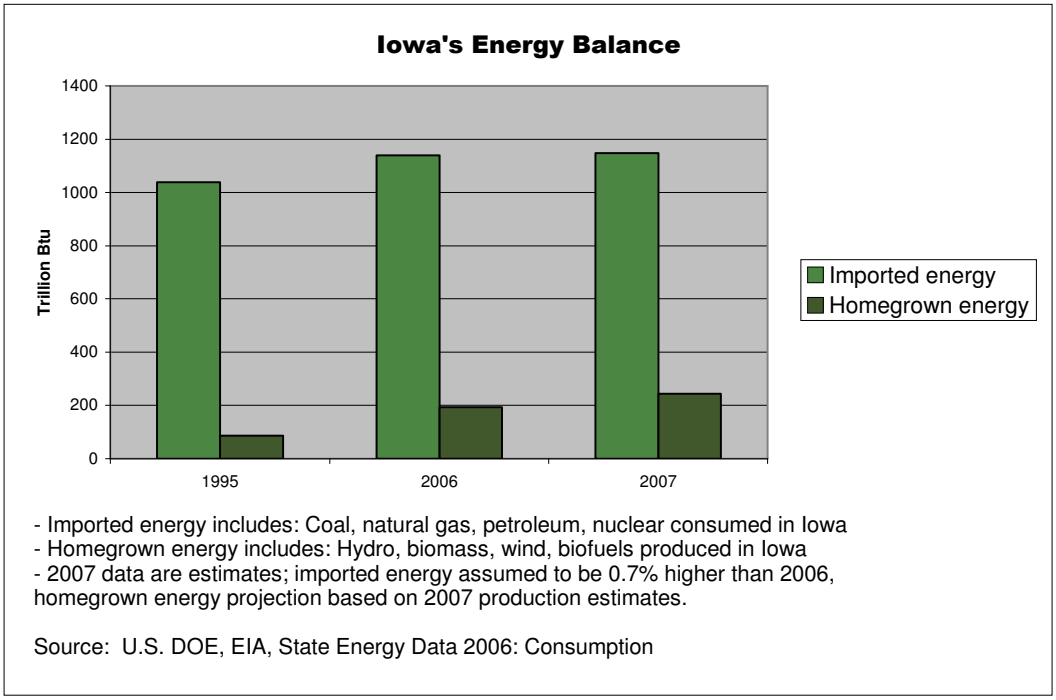
While the majority of Iowa's energy consumption comes from out-of-state resources, it is important to note that Iowa's homegrown energy production has grown rapidly in the last decade. In fact, Iowa's domestic energy production has nearly tripled from 86 Trillion Btu's in 1995 to an estimated 244 Trillion Btu's in 2007. This increase of 185 percent in our state's domestic energy production is mainly due to strong growth in biofuels production and wind energy development. Iowa's other domestic energy sources include hydroelectric power and biomass energy.

Graph 1:



* The domestic energy total includes "biomass"**, "ethanol", "hydroelectric power", and "other"***.
** "Biomass" includes energy from wood and other plant and animal waste.
*** "Other" includes wind, solar, and geothermal energy.
Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Graph 2:



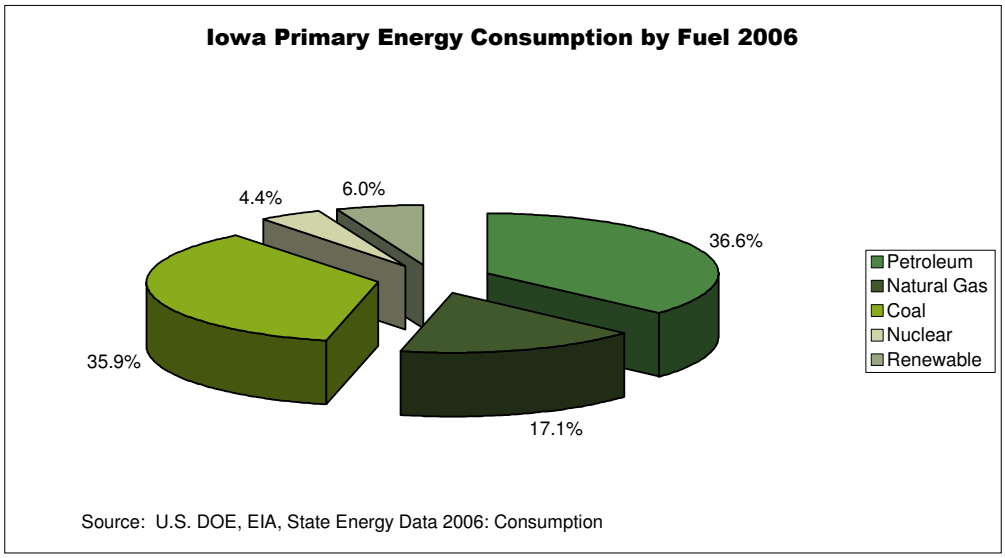
- Imported energy includes: Coal, natural gas, petroleum, nuclear consumed in Iowa
- Homegrown energy includes: Hydro, biomass, wind, biofuels produced in Iowa
- 2007 data are estimates; imported energy assumed to be 0.7% higher than 2006, homegrown energy projection based on 2007 production estimates.

Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Energy Mix

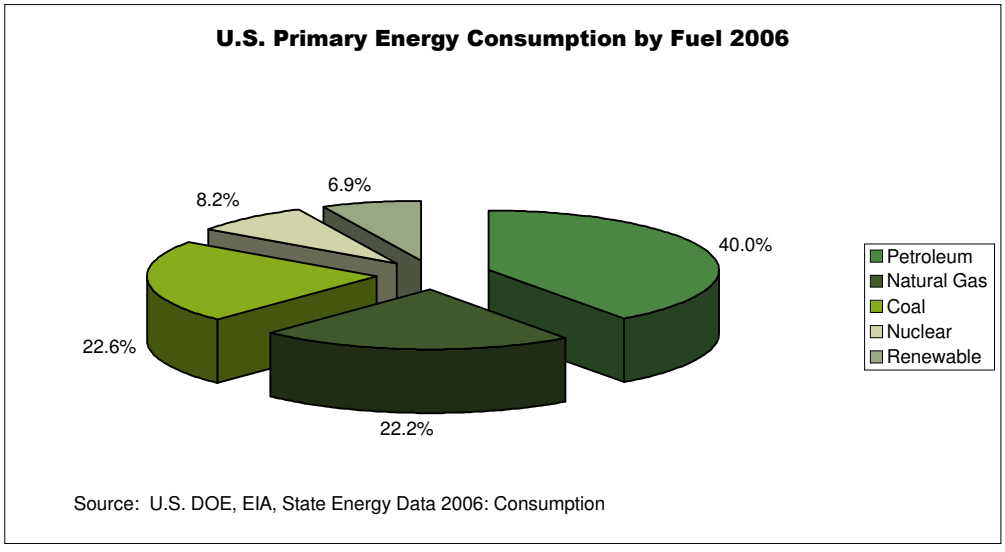
As a percent of total energy consumption in Iowa in 2006 (Graph 3) coal use was 35.9%, petroleum 36.6%, and natural gas 17.1%. Nuclear energy comprised 4.4% of the total and renewable energy (hydro, solar, wind, ethanol and biomass) represented 6.0%. The overall U.S. energy use mix is included in Graph 4. Of particular note is the fact that coal comprises a significantly larger portion of the total energy used in Iowa than in the nation as a whole.

Graph 3:



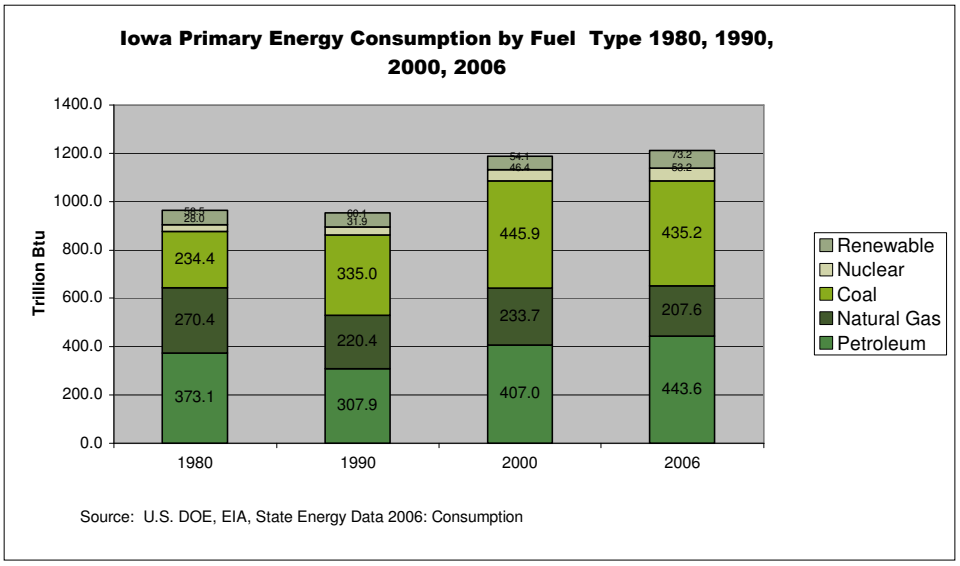
* Renewable Energy includes hydro, geothermal, solar, wind and biomass.

Graph 4:



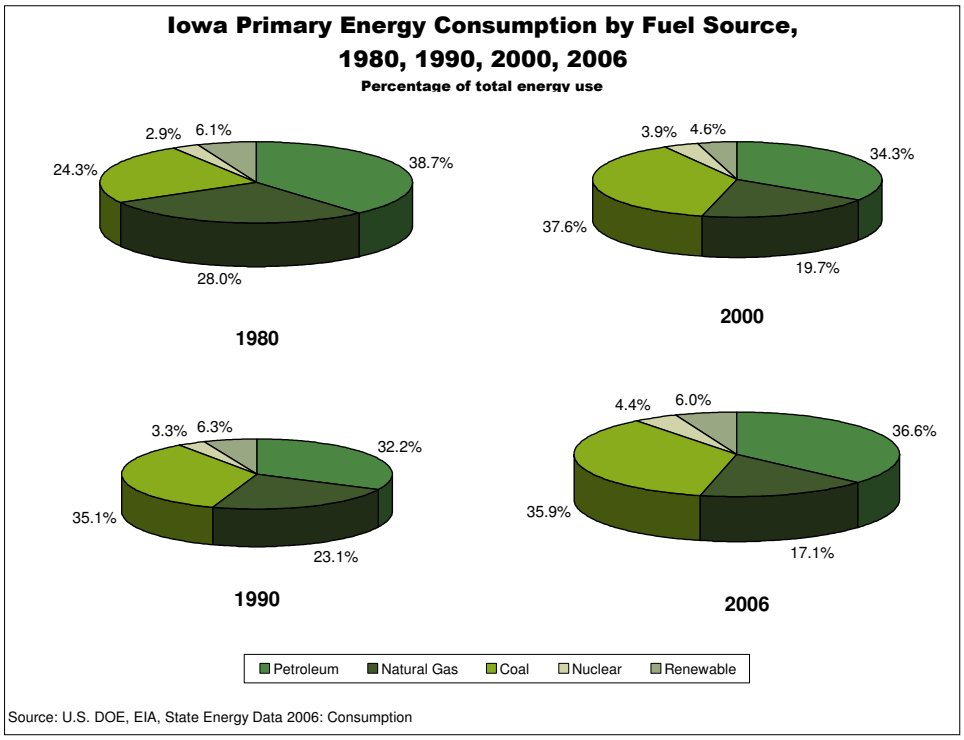
Graphs 5 and 6 and Table 1 show changes in Iowa's energy consumption mix between 1980, 1990, 2000 and 2006. There are several noteworthy trends. Between 1980 and 2000, use of coal increased substantially. The proportion of natural gas use has declined steadily since 1980. Petroleum use declined significantly between 1980 and 1990, but has increased since 1990 and by 2006 was again the most used energy source in Iowa. Use of nuclear energy in Iowa has continued to increase steadily since 1980. Renewable energy use dropped between 1990 and 2000, mainly due to decreased use of biomass resources. The growth in renewable energy use between 2000 and 2006 has been caused by increased use of ethanol and wind energy.

Graph 5:



Graph 6:

Table 1: Iowa Primary Energy Consumption Changes 1980-2006



Fuel	1980-1990 Percentage change	1990-2000 Percentage change	2000-2006 Percentage change	1980-2006 Percentage change
Petroleum	-17.5%	32.2%	9.0%	18.9%
Natural gas	-18.5%	6.0%	-11.2%	-23.2%
Coal	42.9%	33.1%	-2.4%	85.7%
Nuclear	13.9%	45.5%	14.7%	90.0%
Renewable energy	2.7%	-10.0%	35.3%	25.1%

Economic Sectors

As seen in Table 2 below, the Industrial Sector, which includes agricultural activities, is the largest user of energy in Iowa, accounting for 40.8% of all energy consumed in 2006. The next highest energy-using sector is Transportation with a 25.5% share. The Residential Sector accounted for 18.2%, and the Commercial Sector used 15.4% of all energy consumed in Iowa in 2006.

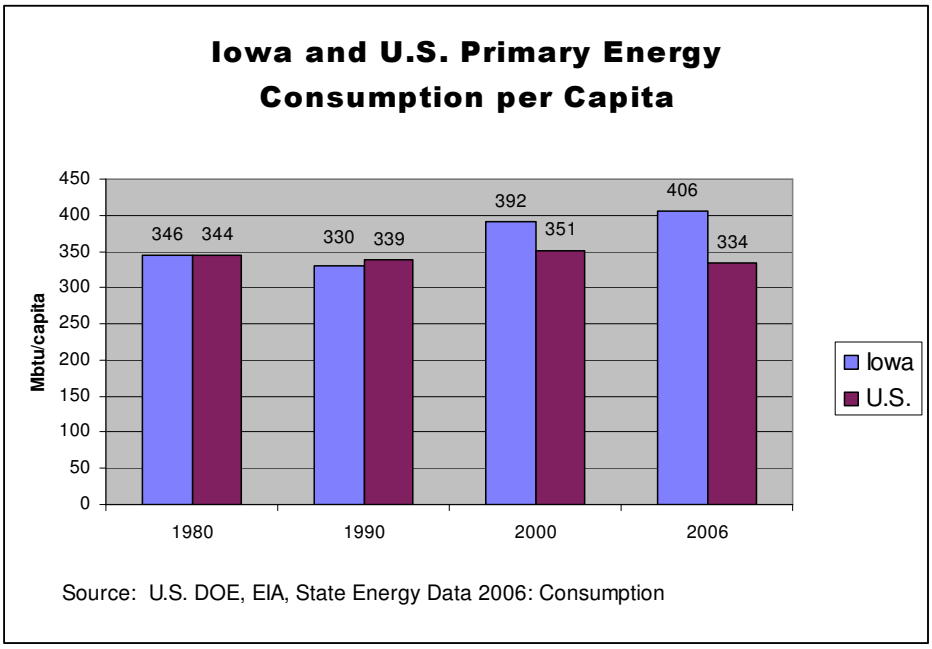
The most significant trend over the years has been the steady decline of the residential energy consumption as a percentage of total energy consumption. Between 1980 and 2006, the portion of residential energy use dropped from 23.9% to 18.2% of total energy use. Over the same time period, actual energy use by the residential sector dropped by 8.9%. All other sectors saw growth in energy use between 1980 and 2006. Fastest energy use growth occurred in the commercial sector at 48%. Industrial energy use grew by 23% and transportation sector 29% between 1980 and 2006.

Table 2: Changes in Iowa Energy Usage by Economic Sector

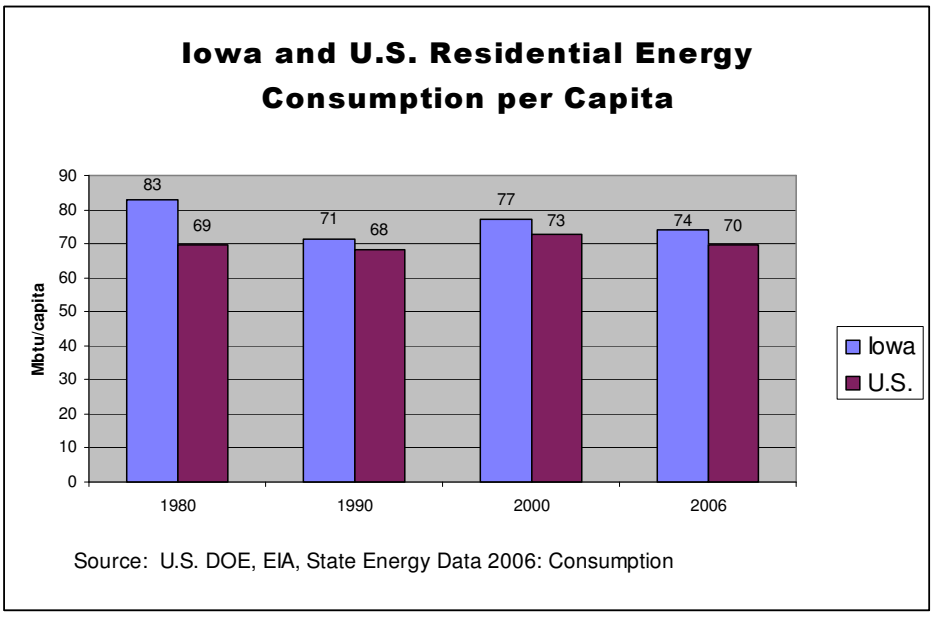
Sector	1980		1990		2000		2006	
	Trillion Btu	Percent	Trillion Btu	Percent	Trillion Btu	Percent	Trillion Btu	Percent
Residential	241.2	23.9%	197.9	21.5%	226.3	19.7%	219.8	18.2%
Commercial	125.7	12.5%	131.0	14.3%	167.1	14.6%	186.5	15.4%
Industrial	402.2	39.9%	354.0	38.5%	483.4	42.1%	492.9	40.8%
Transportation	238.0	23.6%	235.7	25.7%	271.3	23.6%	308.2	25.5%
Total	1,007.1		918.6		1,148.1		1,207.4	

Graphs 7 and 8 detail changes in the total primary energy consumption and residential energy consumption per person in the United States and Iowa. While the per person total energy use in the United States dropped by 2.9% between 1980 and 2006, per person total energy use grew by 17% in Iowa during the same time period. However, per person residential energy consumption declined by 11% in Iowa between 1980 and 2006, while the U.S. residential consumption per person remained virtually unchanged during that time.

Graph 7:



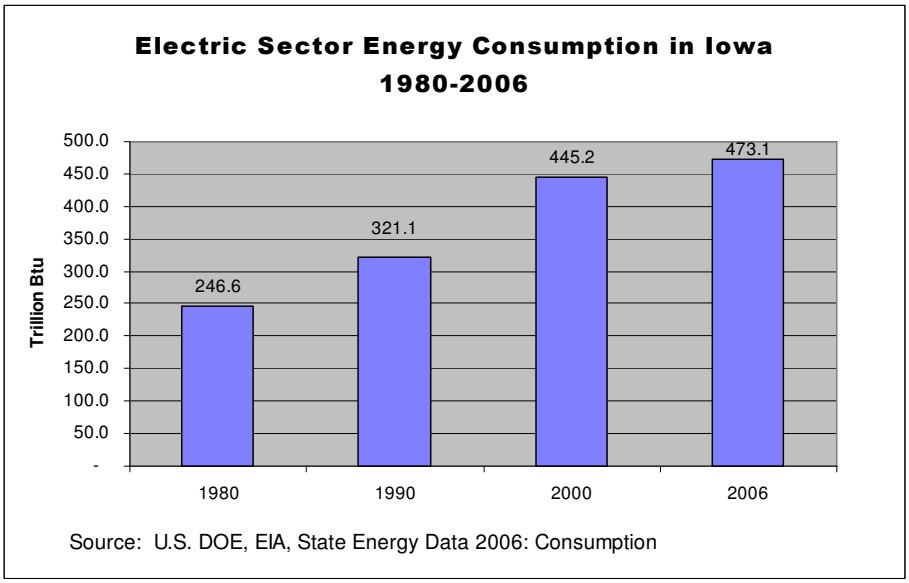
Graph 8:



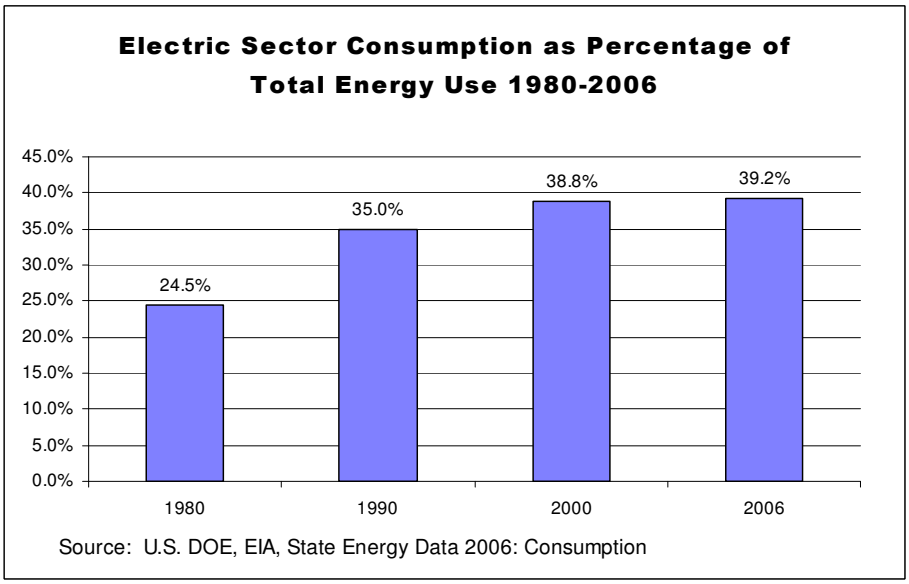
Electric Power Sector

The electric power sector is an important part of Iowa's energy profile. As seen in Graphs 9 and 10, a rapidly increasing percentage of Iowa's total energy use is being consumed by the electric power sector. In 1980, 24.5% of Iowa's total energy use was consumed by the electric power sector. By 2006 that percentage had climbed to 39.2%. Between 1980 and 2006, actual energy consumption in the electric power sector increased by 92%. By comparison, total energy use in Iowa grew by 20% during the same time period.

Graph 9:



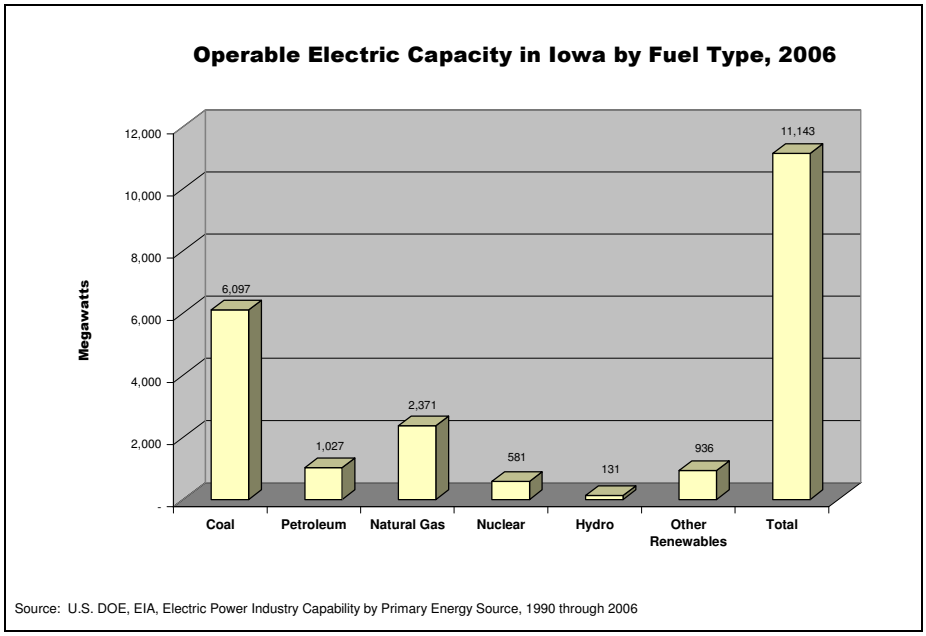
Graph 10:



Graphs 11 and 12 detail electric generation capacity and net generation by fuel type in Iowa. In 2006, coal-fired generation comprised 54.7% of Iowa's electric generation capacity but produced 75.6% of the state's net generation in 2007. This is due to the fact that coal generating plants are used for baseload generation. It is also noteworthy that between 1990 and 2006, coal generation capacity remained practically unchanged, increasing only by 5 megawatts. At the same time, coal-fired electric generation grew by 34%. Generating units using natural gas and petroleum accounted for 30.5% of Iowa's electric capacity in 2006, but only provided 6.6% of net electric generation in 2007. This is explained by the fact that neither natural gas nor petroleum generators are used as baseload generating units in Iowa. However, natural gas generation has increased from 1.1% of total net generation in 1990 to 6.2% in 2007. Since 1990, there has been noticeable growth in use

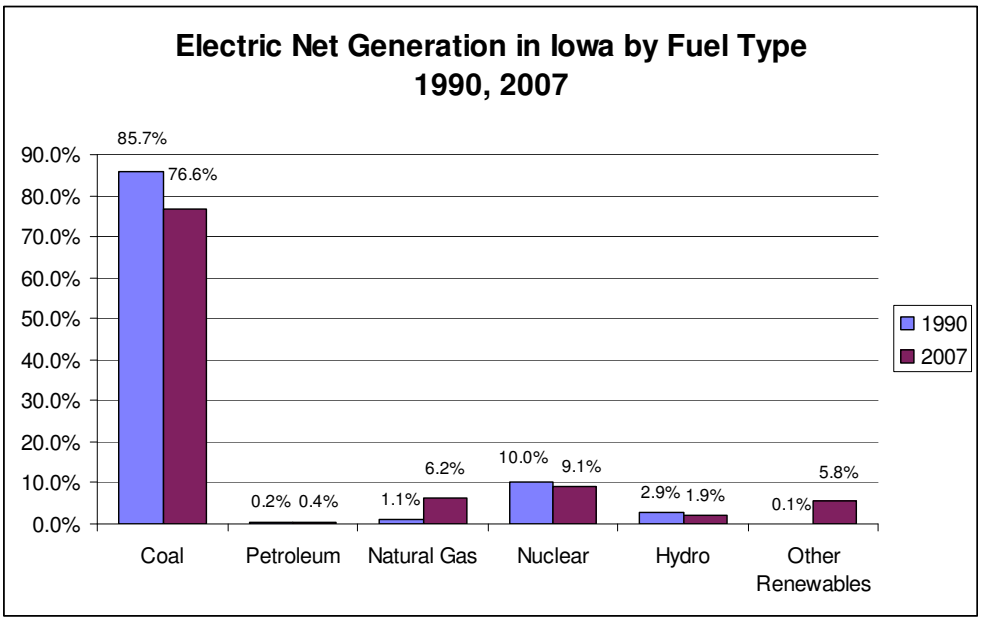
of renewable energy due to rapid growth in wind energy capacity.

Graph 11:



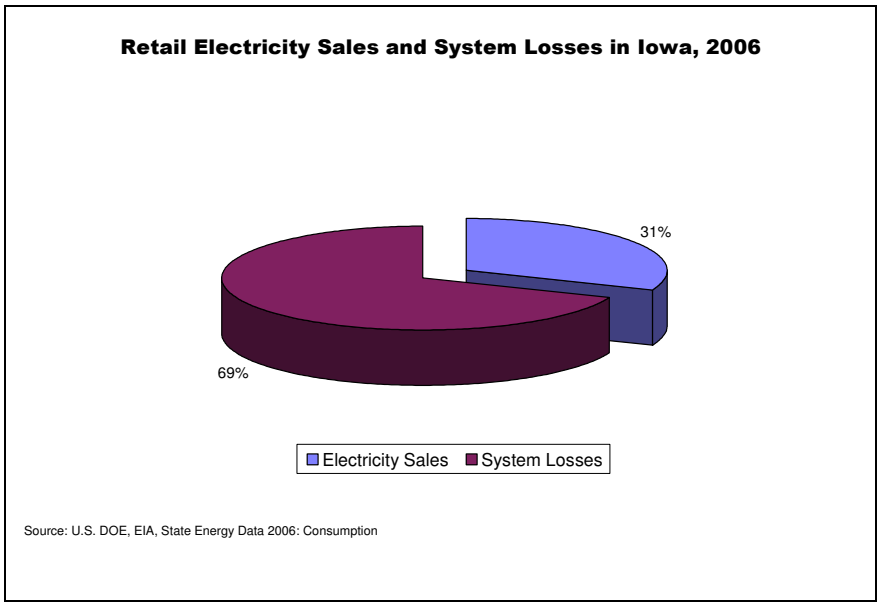
Source: U.S. DOE, EIA, Electric Power Industry Capability by Primary Energy Source, 1990 through 2006

Graph 12:



Graph 13 illustrates the proportion of energy losses in the electric power sector. In 2006, 69% of energy inputs were lost in the generation, transmission, and distribution of electricity. Waste heat in electric generation comprises a large portion of these losses.

Graph 13:

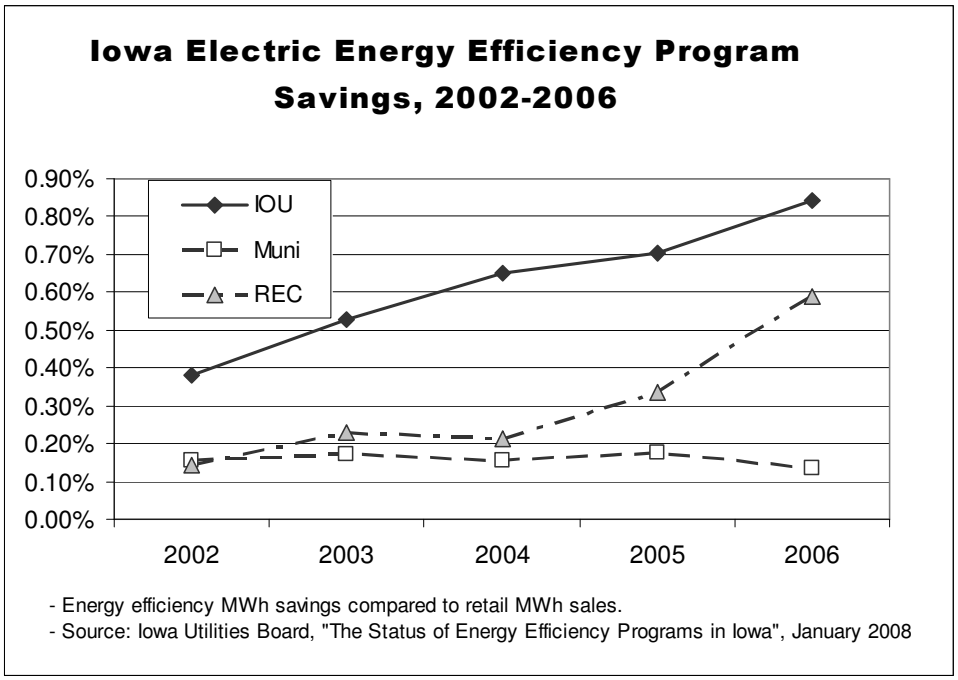


Iowa utilities have a long record of running energy efficiency programs. Iowa's investor-owned utilities – MidAmerican Energy, Alliant Energy, and Black Hills Energy – are required to offer energy efficiency programs for their customers. Iowa Utilities Board (IUB) approves the energy efficiency plans for the investor-owned utilities. IUB does not have similar authority over the energy efficiency programs of municipal utilities and rural electric cooperatives, but most of Iowa's consumer-owned utilities offer energy efficiency programs to their customers.

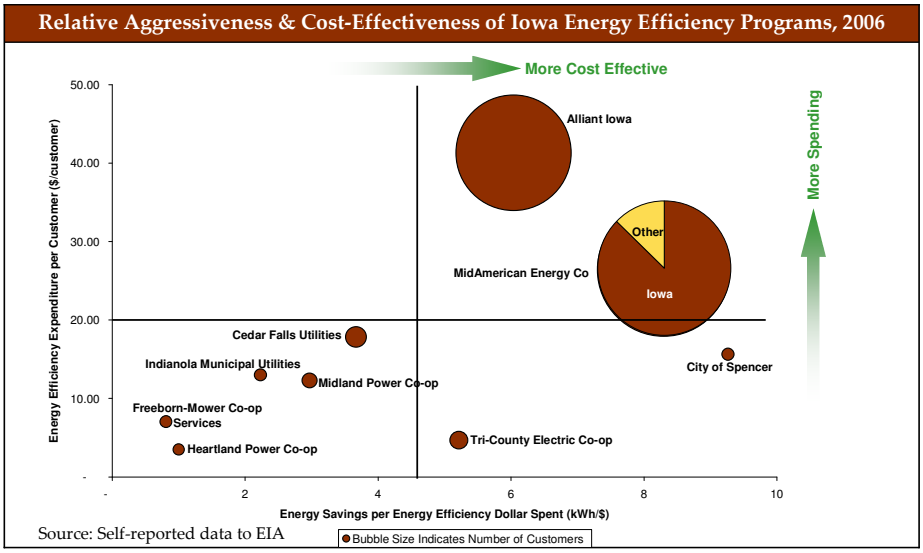
Iowa Utilities Board evaluated the effectiveness of Iowa utilities' energy efficiency program in a report published in January 2008. A summary of the effectiveness of electric energy efficiency programs is included in Graph 14. In 2006, Iowa's investor-owned utilities achieved 0.8 percent in incremental electric energy efficiency savings compared to retail sales. Rural electric cooperatives' savings were 0.60 percent and municipal utilities achieved savings of 0.15 percent.

In its 2008 report to the Iowa Office of Energy Independence, Navigant Consulting also evaluated Iowa's energy efficiency programs based on data from 2006. Graph 15 includes a comparison of Iowa utilities' energy efficiency program aggressiveness and cost effectiveness. Graph 16 compares Iowa's investor-owned utility programs to other utilities in the Midwest.

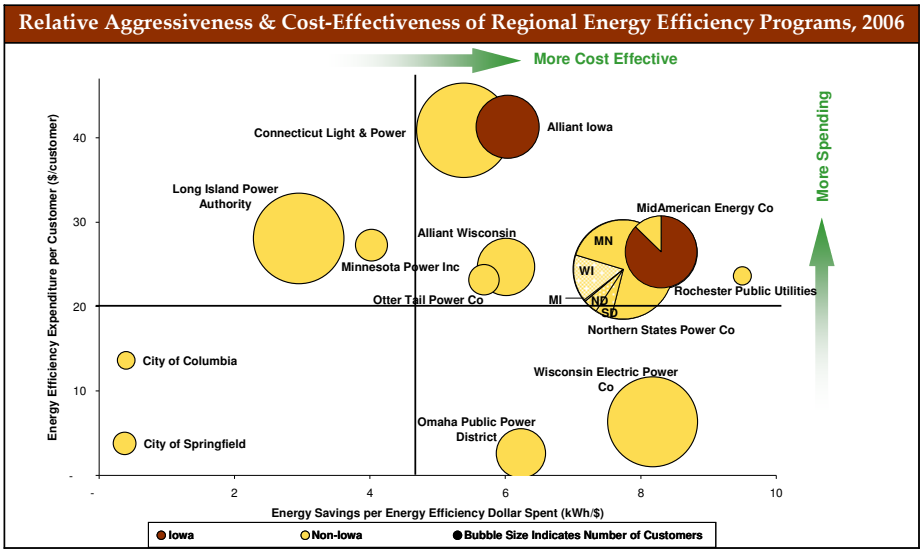
Graph 14:



Graph 15:



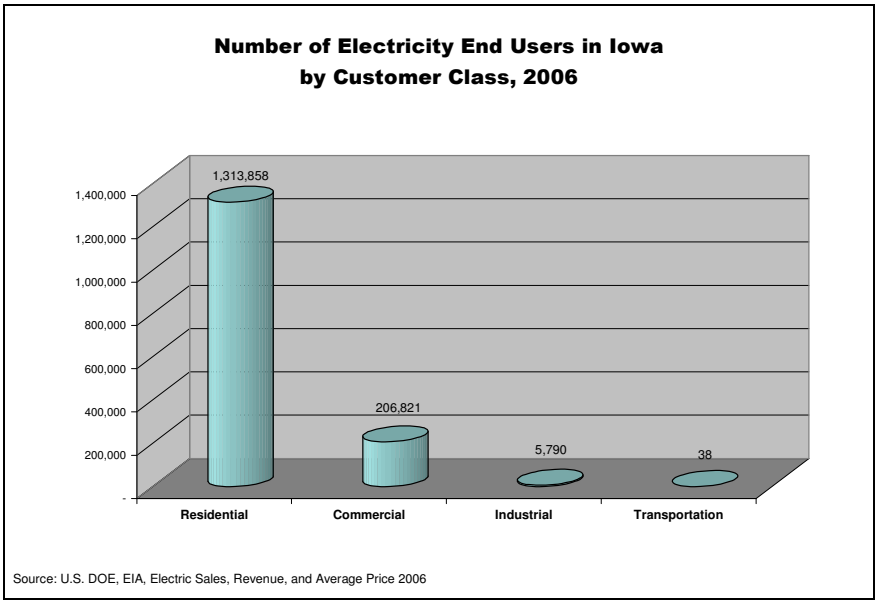
Graph 16:



Source: Self-reported data to EIA

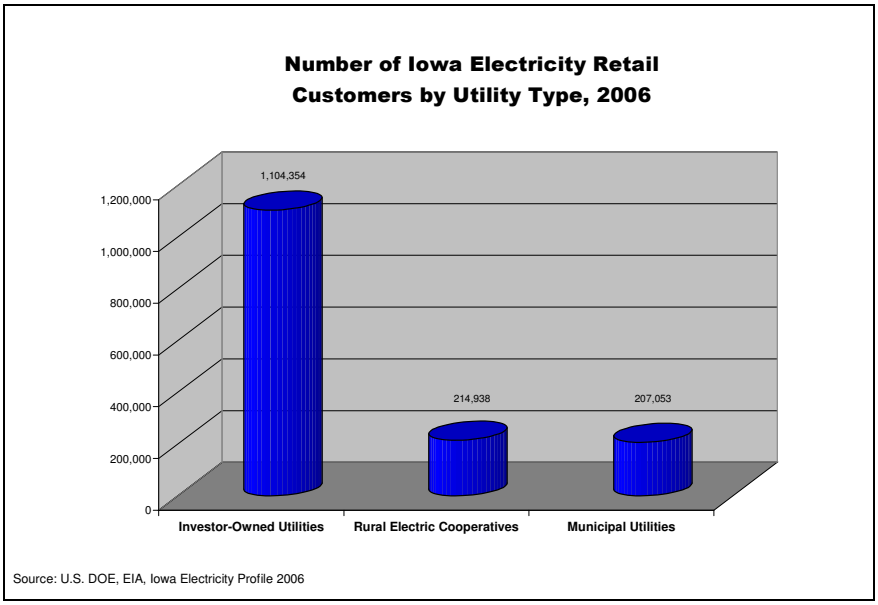
Graphs 17 and 18 illustrate the structure of Iowa's electric power sector. Graph 17 indicates the number of electric end users by customer class and Graph 18 includes the breakdown of Iowa electric end users by utility type. In 2006, 72.4% of Iowa's electric customers were served by investor-owned utilities, 14.1% by rural electric cooperatives, and 13.6% by municipal utilities. Graph 19 includes electric service territories in Iowa.

Graph 17:



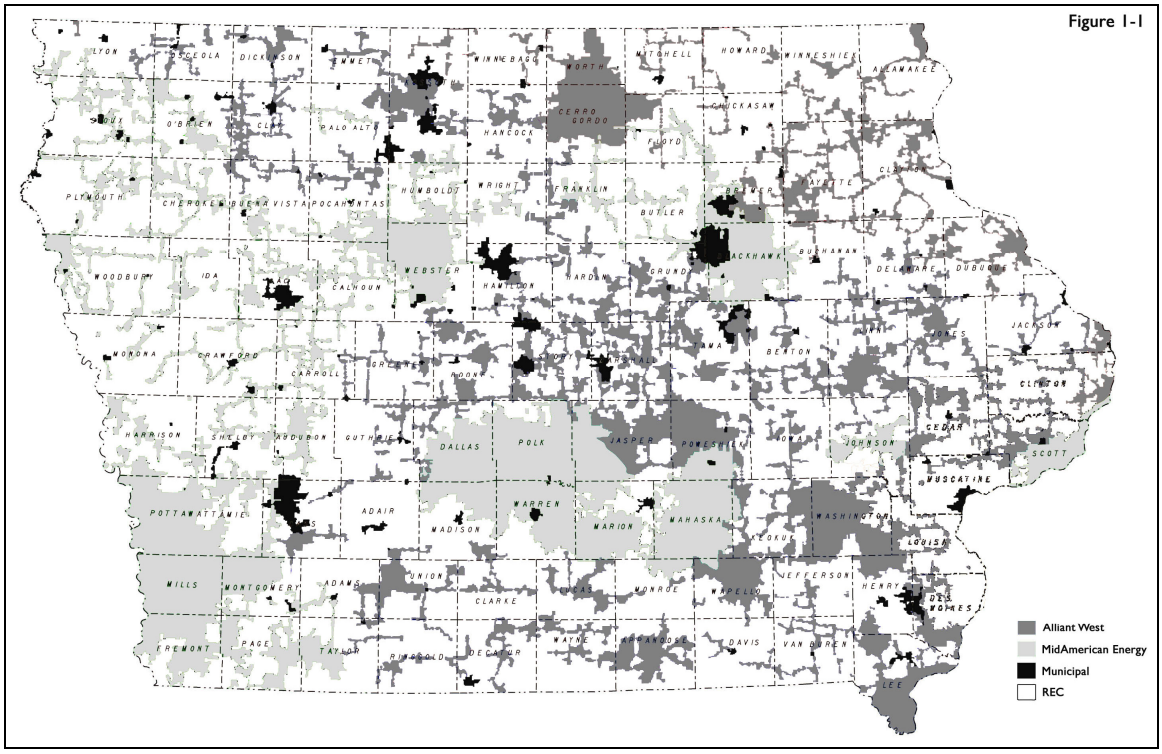
Source: U.S. DOE, EIA, Electric Sales, Revenue, and Average Price 2006

Graph 18:



Source: U.S. DOE, EIA, Iowa Electricity Profile 2006

Graph 19: Iowa Electric Utility Service Territories

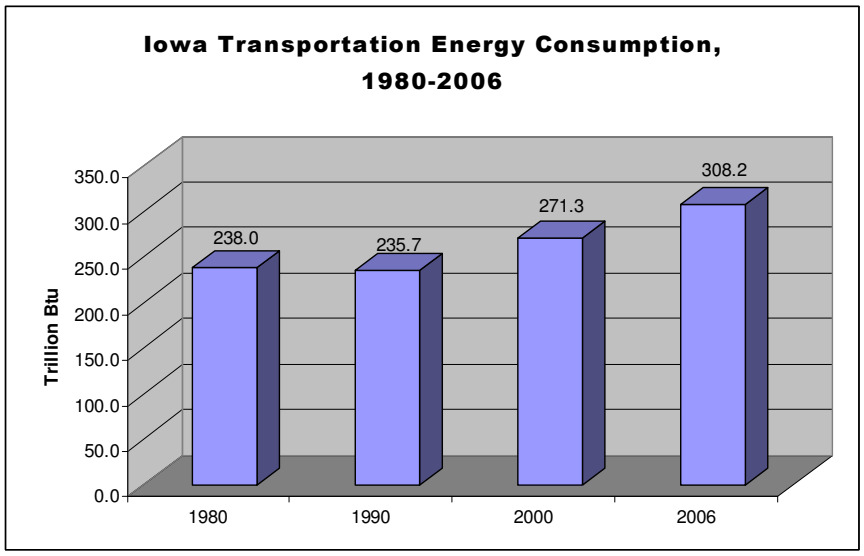


Source: Iowa Utilities Board

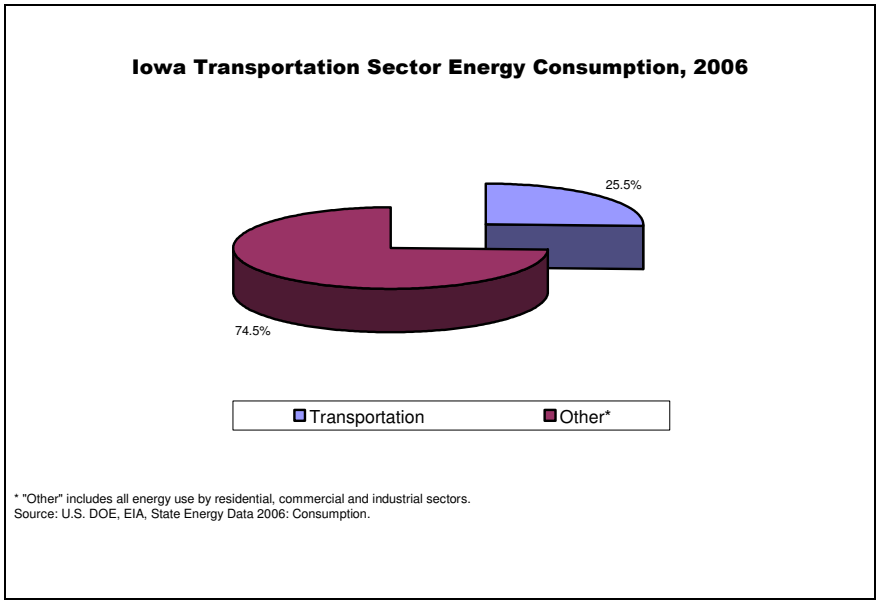
Transportation Sector

Between 1980 and 1990, Iowa's transportation sector saw a slight decrease in energy consumption, as indicated in Graph 20. Since 1990, however, transportation sector energy consumption has increased steadily in Iowa. Between 1990 and 2006, energy use in the transportation sector grew by 31%. Transportation sector consumed 25.5% of Iowa's total energy consumption in 2006, as indicated in Graph 21. This is a slightly smaller portion than the U.S. figure of 28.9% (Graph 22).

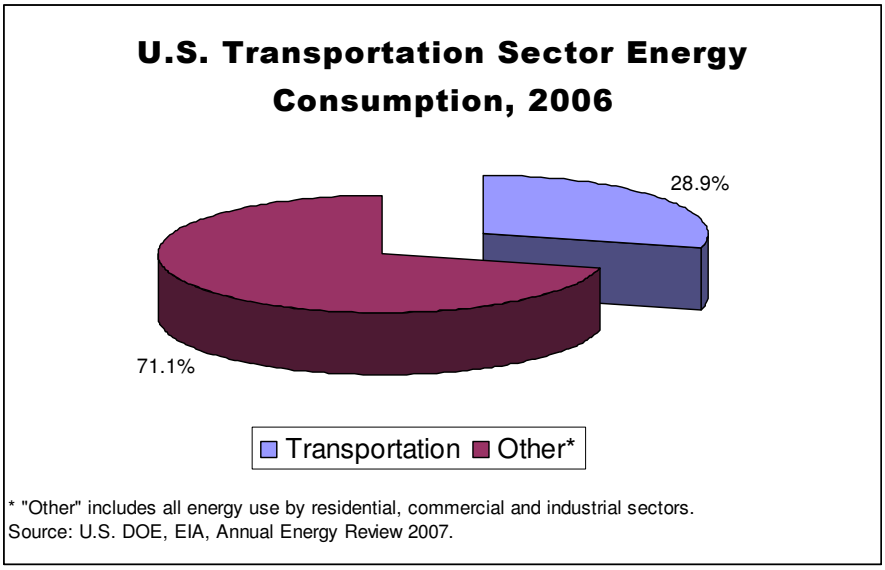
Graph 20:



Graph 21:

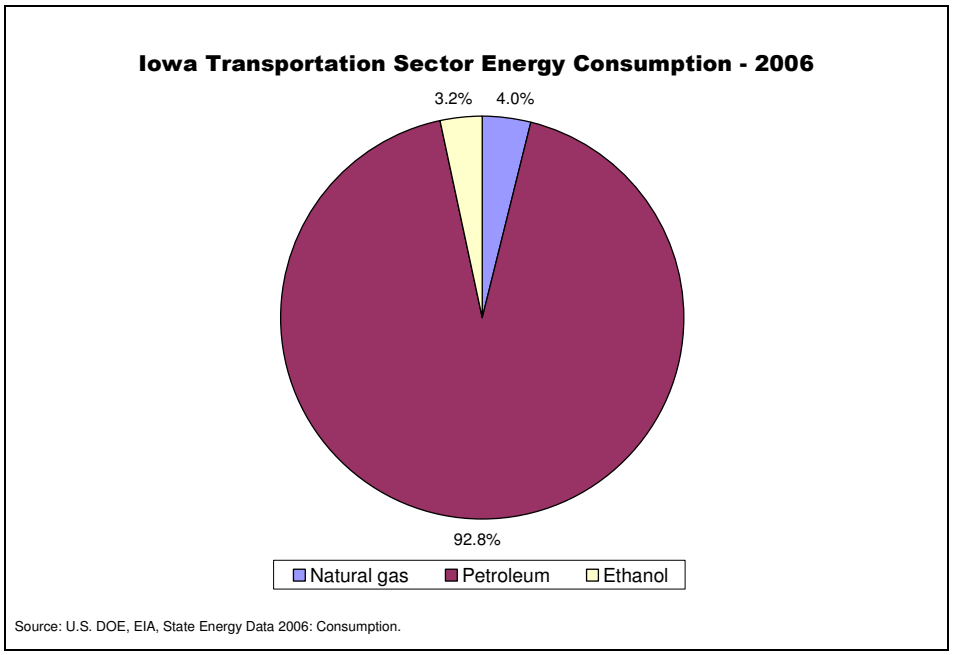


Graph 22:



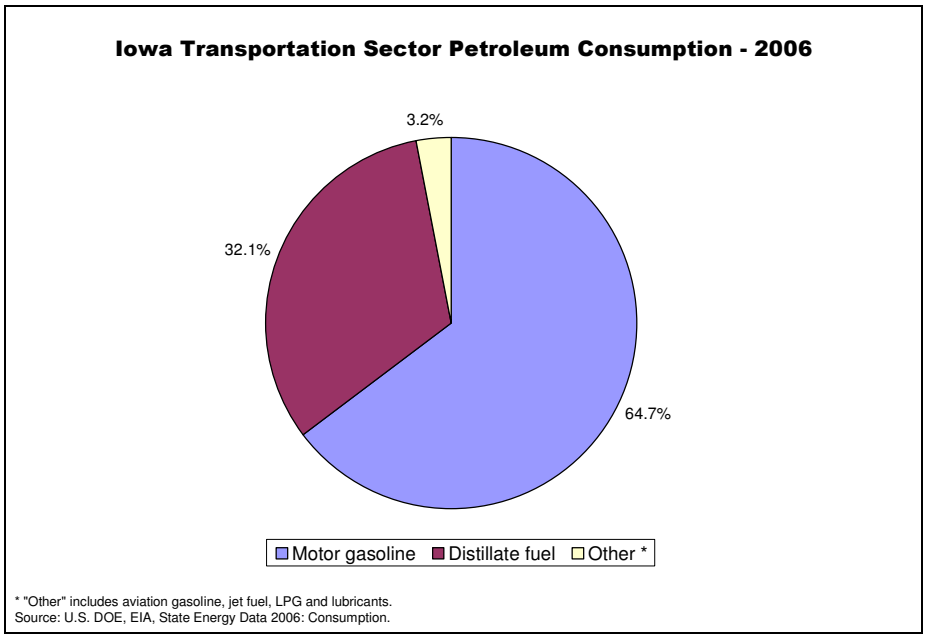
Graphs 23, 24 and 25 further illustrate Iowa transportation sector's fuel consumption. Graph 23 indicates that of all Iowa transportation sector fuel consumption in 2006, 92.8% was petroleum. The reminder of transportation sector fuel consumption consisted of natural gas and ethanol.

Graph 23:



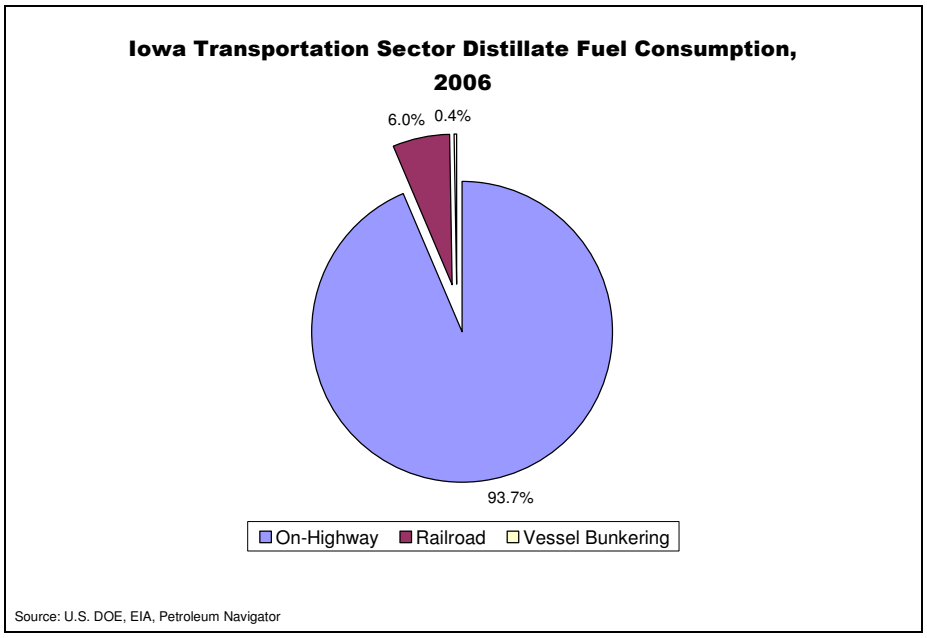
Graph 24 breaks down the composition of Iowa's petroleum consumption in the transportation sector. Of all petroleum consumption in the transportation sector in 2006, 64.7% was motor gasoline and 32.1% distillate fuel.

Graph 24:



Graph 25 further breaks down Iowa's transportation sector distillate fuel consumption. In 2006, 93.7% of distillate fuel was consumed by on-highway vehicles. Railroads consumed 6.0% and marine industry 0.4% of distillate fuel consumption in 2006.

Graph 25:

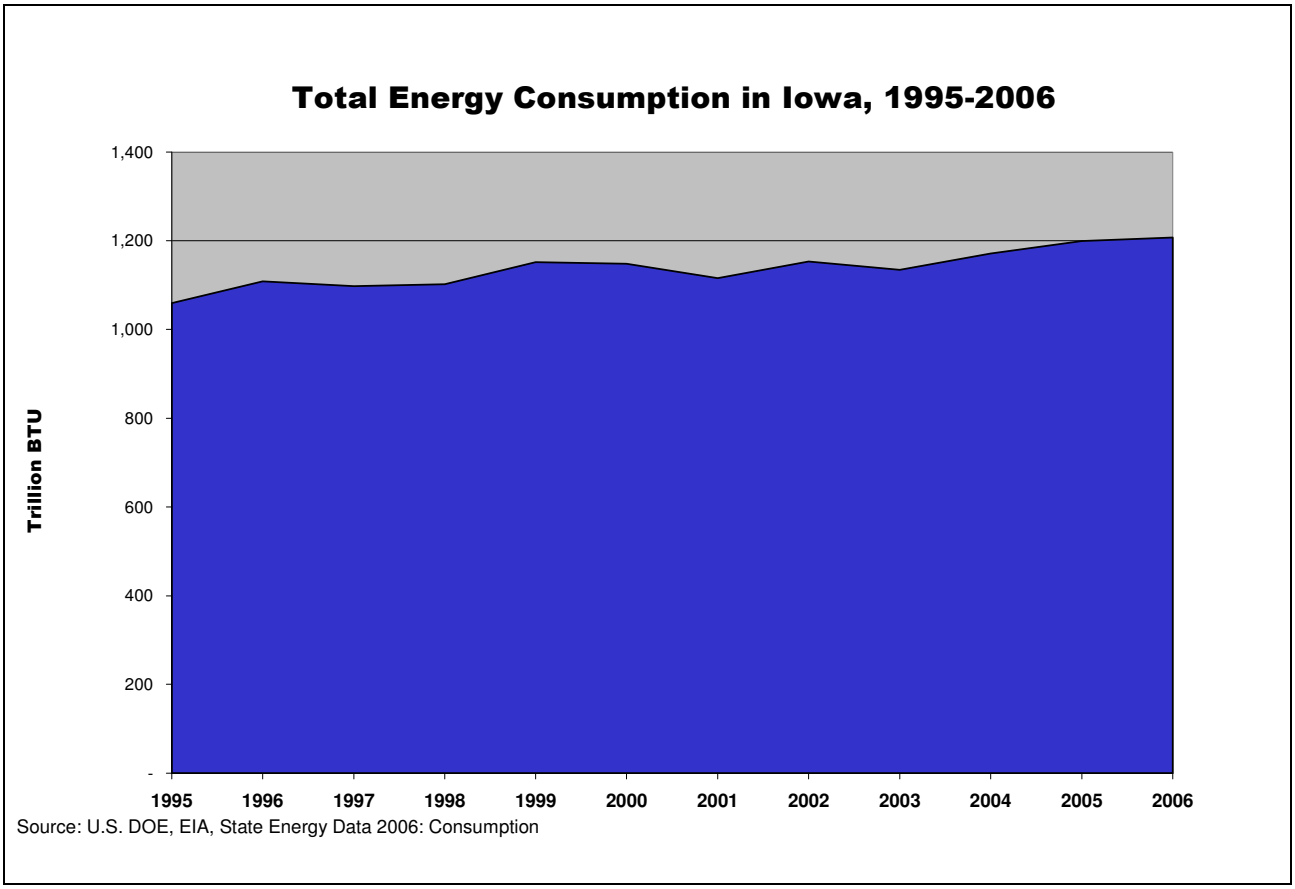


B. Growth rate of energy consumption in Iowa, including rates of growth for each energy source.

Total Energy Consumption

Iowa's 2006 total energy consumption was 1,207 Trillion BTUs, which is 13.9% higher than the 1,060 BTUs in 1995.

Graph 26:

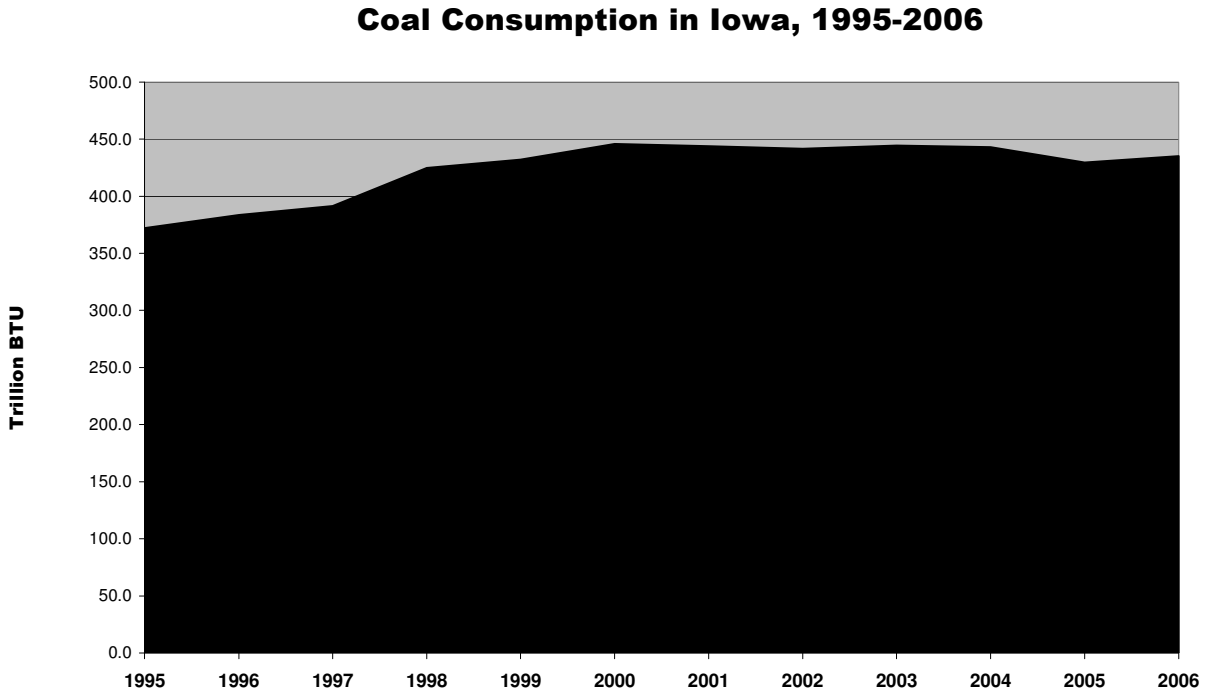


Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Coal

Coal consumption increased by 16.9% between 1995 and 2006. Iowa's coal used peaked in 2000 and slightly decreased between 2000 and 2006.

Graph 27:

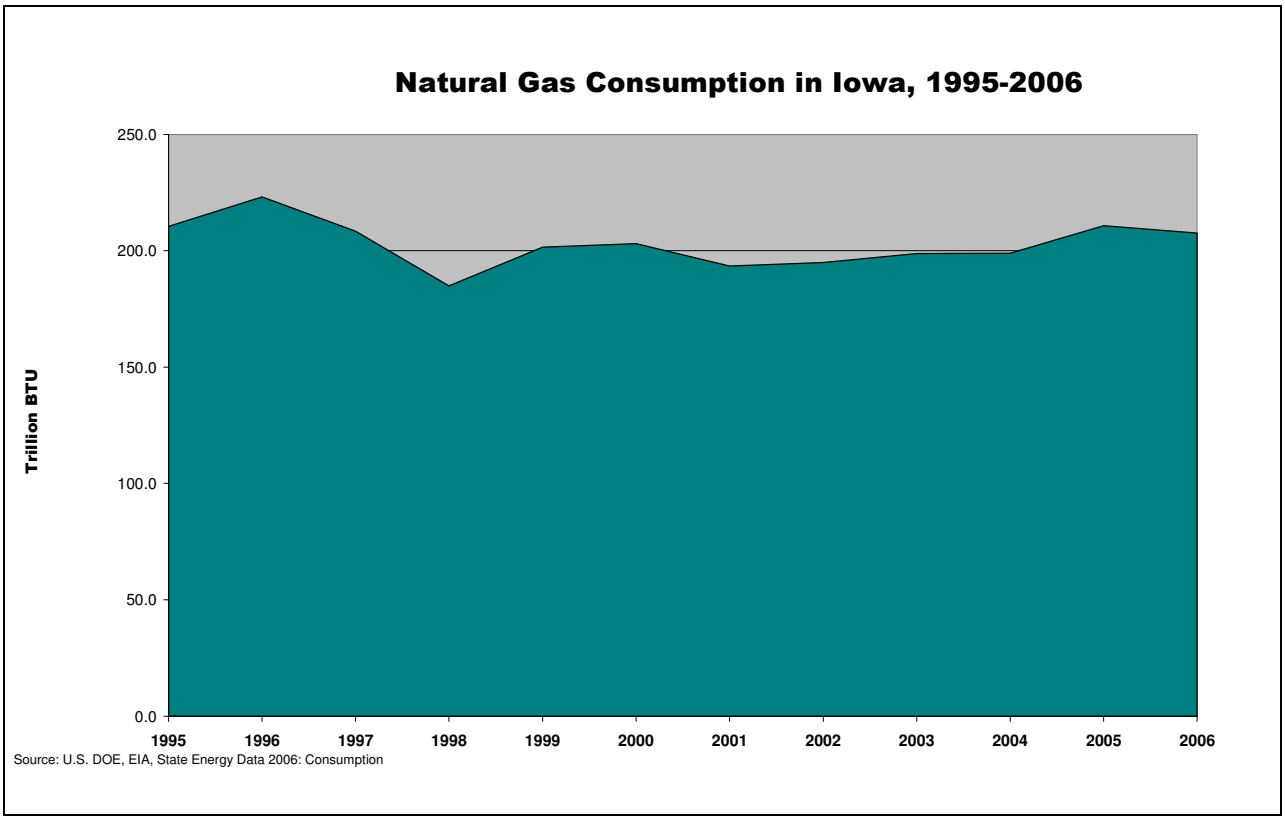


Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Natural Gas

Between 1995 and 2006, natural gas use declined 1.4% in Iowa. Its use peaked in 1996 and consumption stayed at lower level until 2004. In 2005 and 2006 natural gas use increased again, reaching nearly the same level as in 1995.

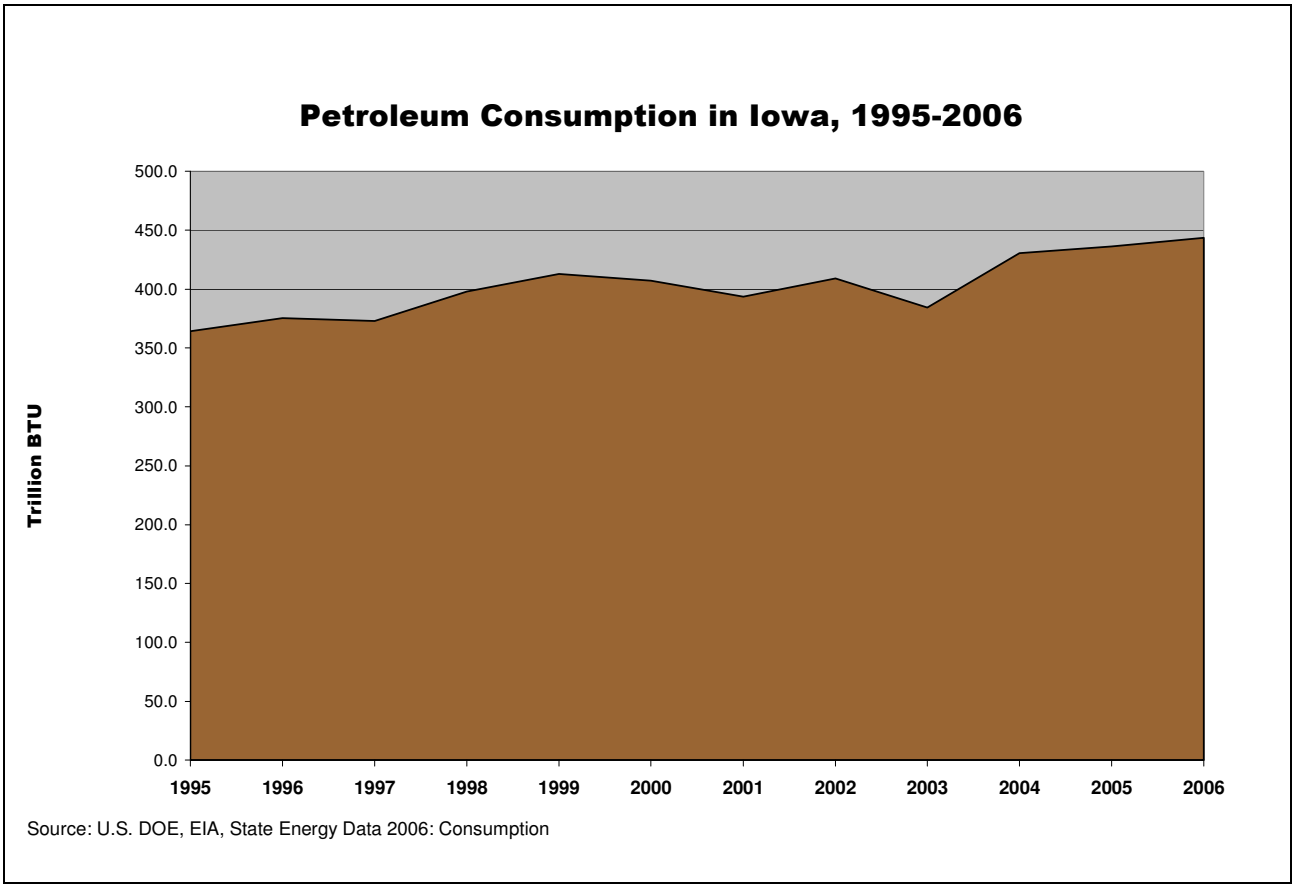
Graph 28:



Petroleum

Petroleum consumption grew 21.8% between 1995 and 2006 in Iowa. Growth was particularly rapid in 2004 when consumption rose 12.0% compared to 2003 despite oil and gasoline prices being higher in 2004 than in 2003. Strong economic growth in 2004 was likely a significant factor behind the jump in petroleum consumption.

Graph 29:

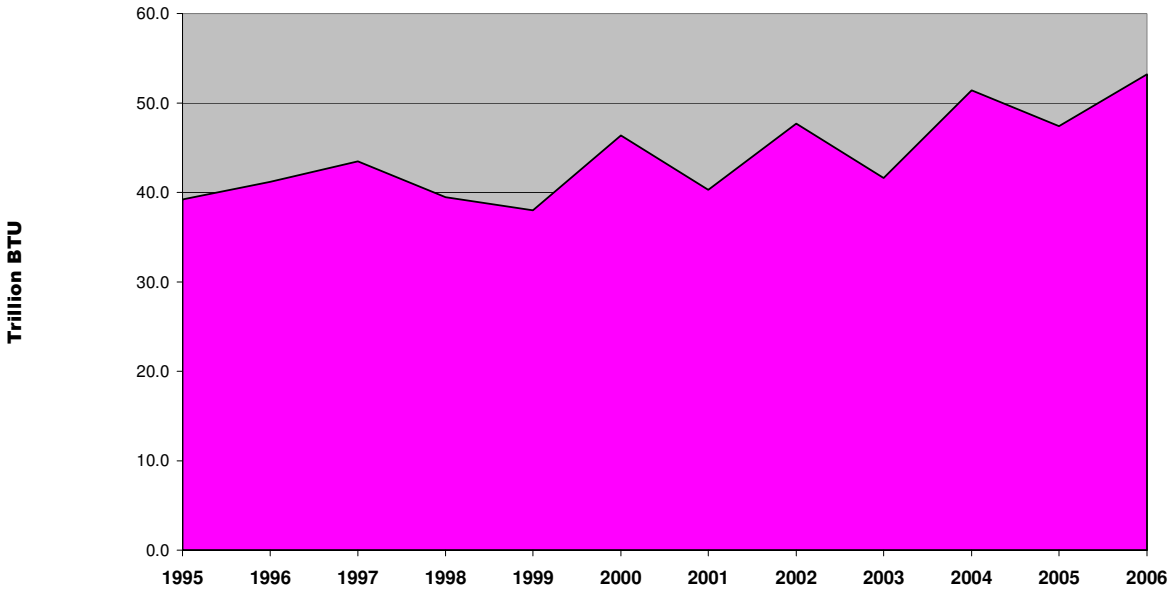


Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Nuclear Energy

Between 1995 and 2006, consumption of nuclear energy grew by 35.7%. Growth has been somewhat uneven, but the overall trend has been steady growth in the use of nuclear energy.

Graph 30:



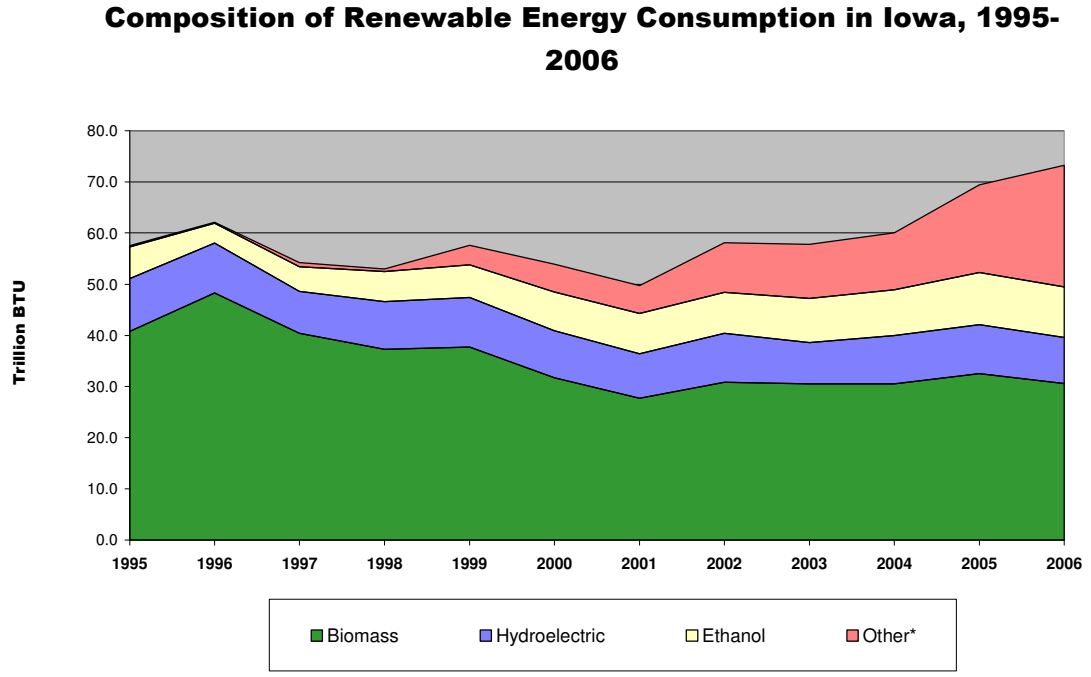
Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Renewable Energy

Graph 31 shows changes in renewable energy consumption and composition between 1995 and 2006. Overall, use of renewable energy increased 27.3% during the time period. Among the different types of renewable energy, use of hydroelectric power has remained steady between 1995 and 2006. Use of biomass declined during this time period and ethanol consumption has steadily increased. The category “other” renewable energy, which includes wind, solar and geothermal energy, has grown rapidly since 1999. This is due to the fast growth of wind energy capacity in Iowa.

When analyzing Iowa data, it is important to note the difference between renewable energy consumption and production. With both ethanol and biodiesel, a relatively small portion of the fuel produced in Iowa is actually consumed in Iowa. Most of the production is exported. In addition, some Iowa wind farms produce electricity for out-of-state utilities and consumers. However, in the below data, all wind energy produced in Iowa is considered to be consumed in Iowa.

Graph 31:



Source: U.S. DOE, EIA, State Energy Data 2006: Consumption.
*"Other" category includes wind, photovoltaic, geothermal and solar thermal energy.

C. Projection of Iowa's energy needs at a minimum through the year 2025

One must be aware of the precision and usefulness of long-term energy projections. We are unaware of any predictions from recent years that accurately portray the current mix of demographic, technological, economic, and political factors that have shaped Iowa’s contemporary energy needs and consumption. Recognizing the inherent unreliability of forecasts so dependent on many unknown and inter-related variables, this section contains

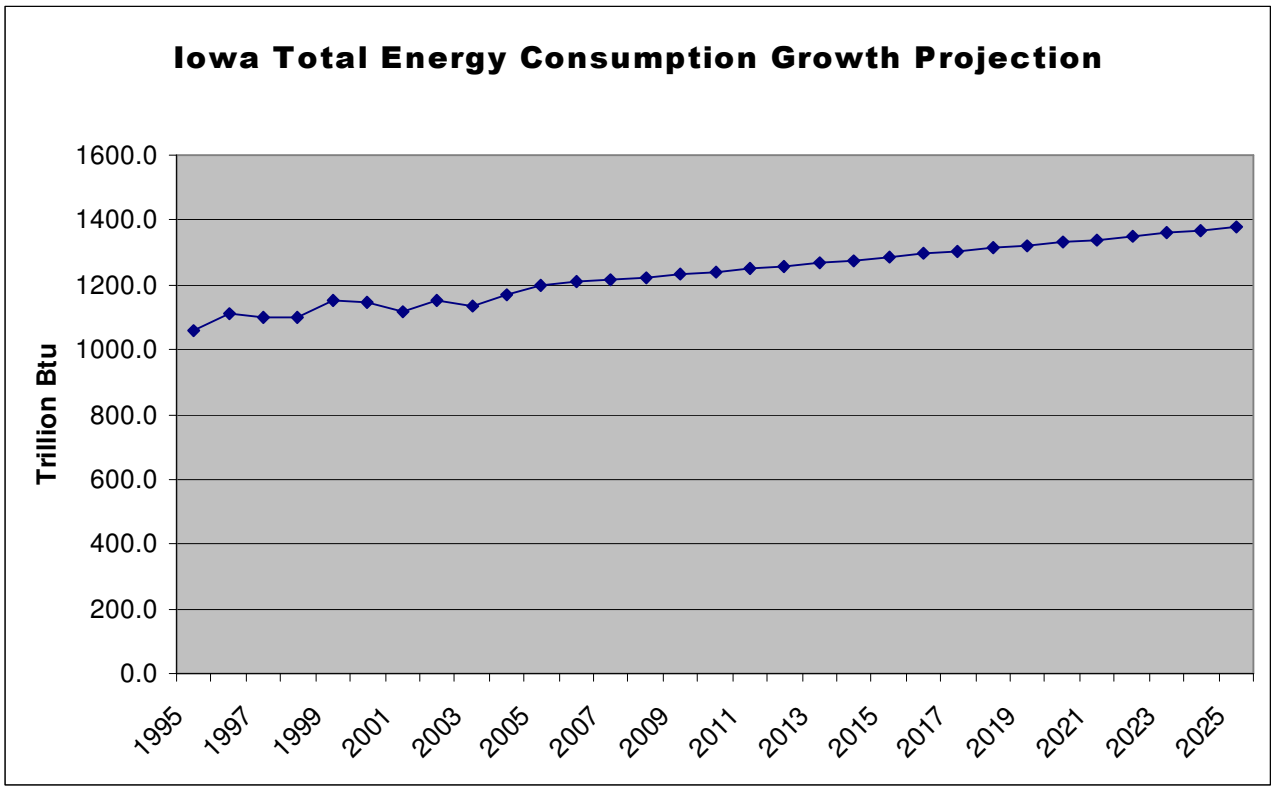
an illustration of Iowa's total energy consumption projected from 2006 data up to the year 2025 based the latest projected energy consumption growth rate from the U.S. Department of Energy, Energy Information Administration. In addition, an illustration of Iowa's expected electricity consumption growth based on utility projections is included along with a projection of Iowa's motor gasoline consumption.

It should also be noted that these growth projections are based on assumptions that expect the energy sector fundamentals to stay on a "business as usual" trajectory. The State of Iowa is working to implement many efforts to influence the future energy consumption rate and composition of Iowa's energy use mix. These efforts and policies may have significant impact on the energy projections in this report.

Total Energy Consumption

Iowa's total energy consumption in 2006 was 1,207 trillion BTUs. According to U.S. DOE's Energy Information Administration's Annual Energy Outlook 2008, total energy consumption is expected to grow at an average annual rate of 0.7% between 2007 and 2025. At this growth rate, Iowa's estimated total energy consumption is expected to be 1,379 Trillion BTUs in 2025. This would be an increase of 14 percent over 2006.

Graph 32:

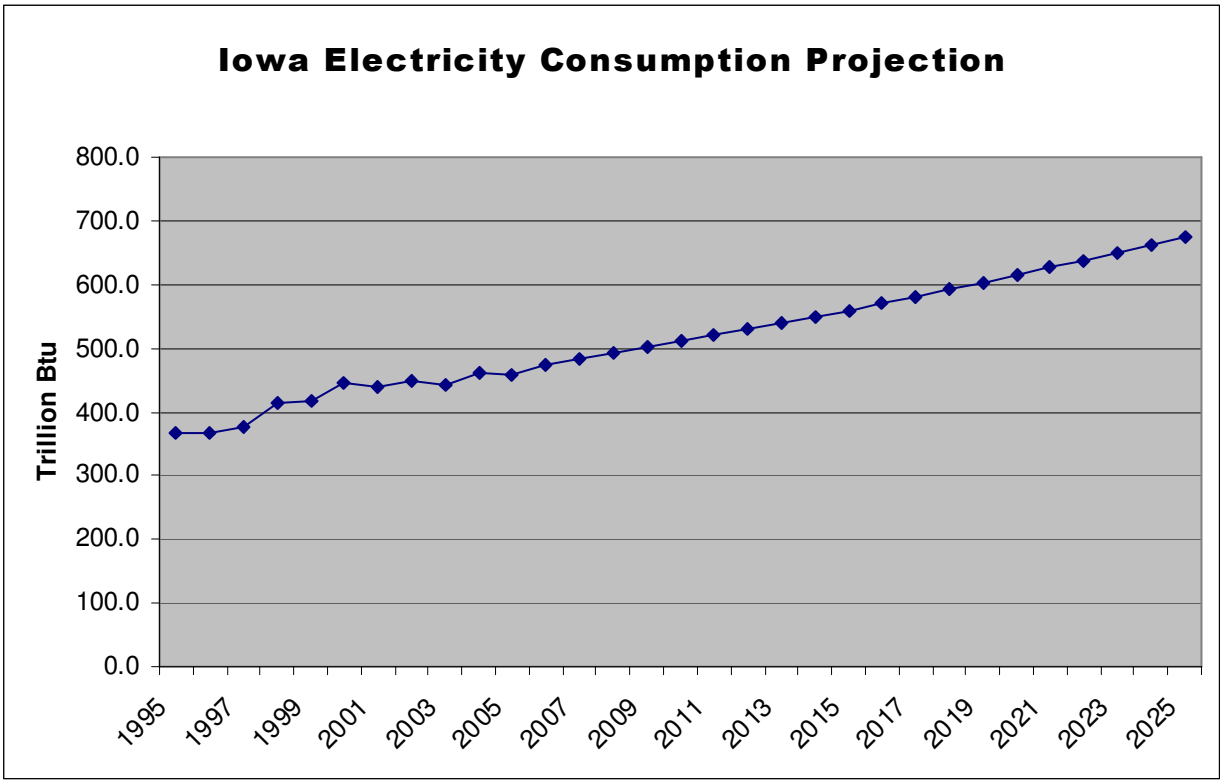


Electricity Consumption

In 2005, Iowa's electric power sector consumption was at 473 Trillion BTUs. "Iowa GHG Inventory and Reference Case Projection" produced by Center for Climate Strategies estimates that Iowa's electricity demand will increase at an average annual rate of 1.89% between 2007 and 2025. At this growth rate, Iowa's electric power sector consumption is expected to be 675 Trillion BTUs. This would be an increase of 43% over 2006.

The average annual growth rate of 1.89% is greater than the 1.1% projected U.S. annual average growth for electricity consumption in the Annual Energy Outlook 2008 report by the Energy Information Administration of the U.S. Department of Energy. The Center for Climate Strategies growth rate estimate is based on information provided by Iowa utilities and can be expected to be a more reliable prediction for Iowa consumption growth.

Graph 33:

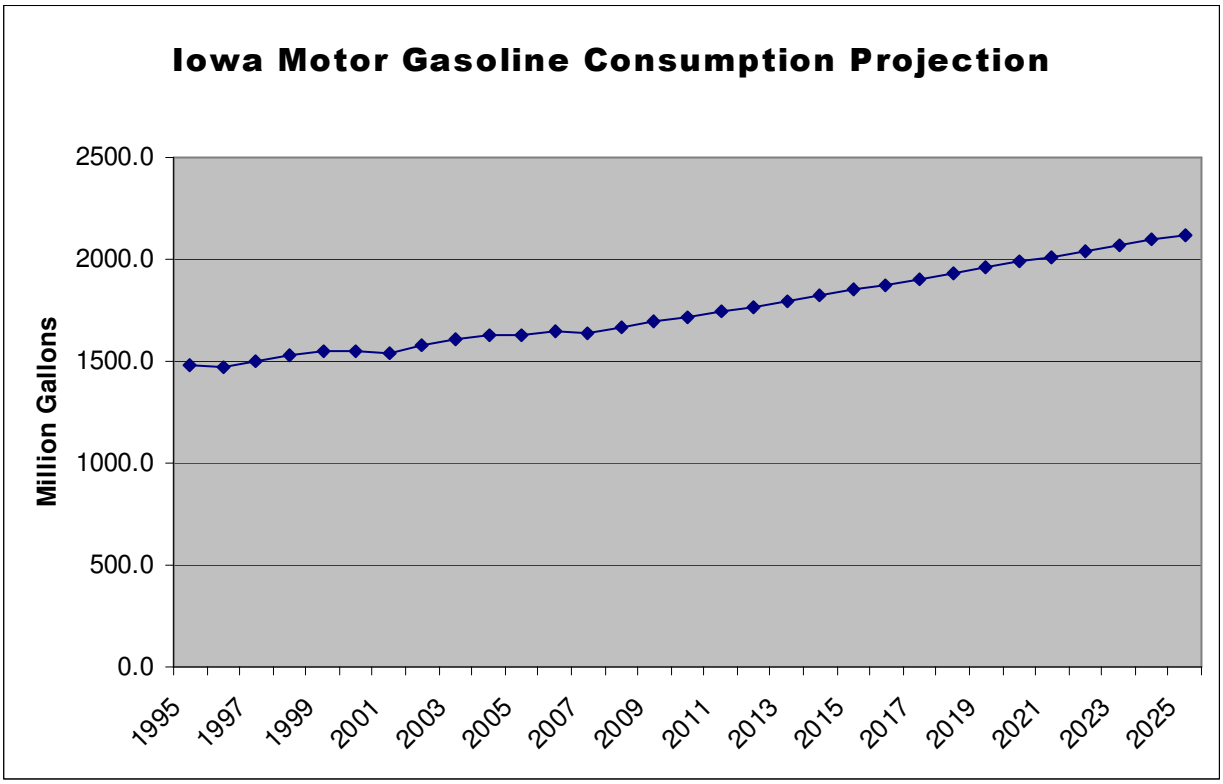


Motor Gasoline

Iowa's motor gasoline sales in 2007 were 1.64 billion gallons. "Iowa GHG Inventory and Reference Case Projection" produced by Center for Climate Strategies estimates that Iowa's on-road gasoline consumption will increase at an average annual rate of 1.5% between 2007 and 2020 and at 1.3% between 2020 and 2025. At this growth rate, Iowa's motor gasoline consumption is expected to be 2.12 billion gallons in 2025. This would be an increase of 29% over 2007.

The average annual growth rate estimated by Center for Climate Strategies is greater than the 0.7% projected U.S. annual average growth for transportation sector liquid fuels consumption in the Annual Energy Outlook 2008 report by the Energy Information Administration of the U.S. Department of Energy. The Center for Climate Strategies growth rate estimate is based on Iowa-specific information and can be expected to be a more reliable prediction for Iowa consumption growth.

Graph 34:



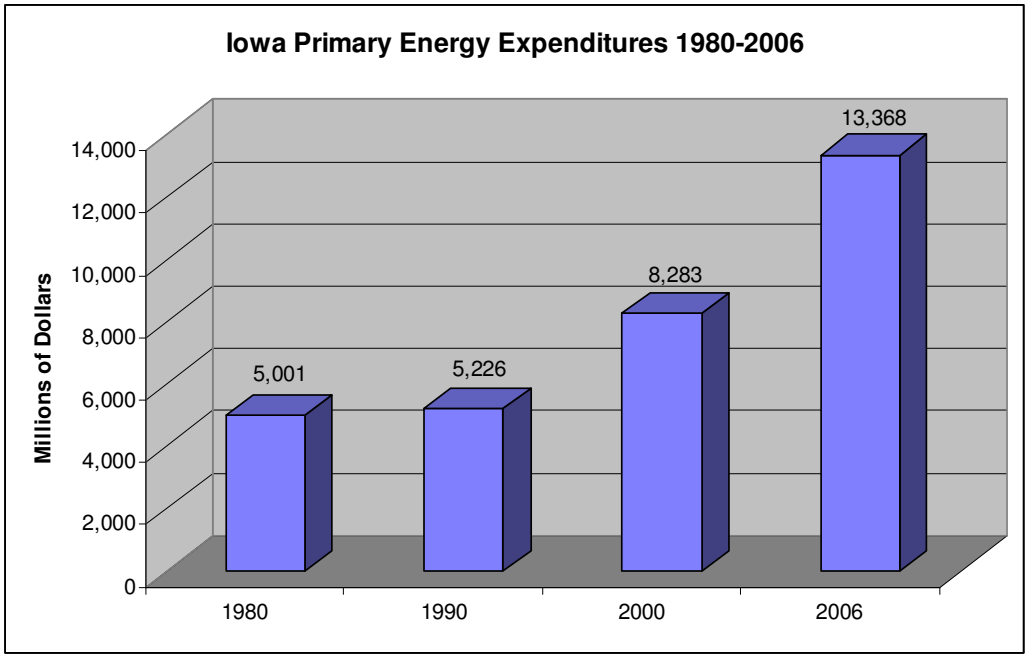
D. Impact of meeting Iowa's energy needs on the economy of the state, including the impact of energy efficiency and renewable energy on employment and economic development

Energy Expenditures

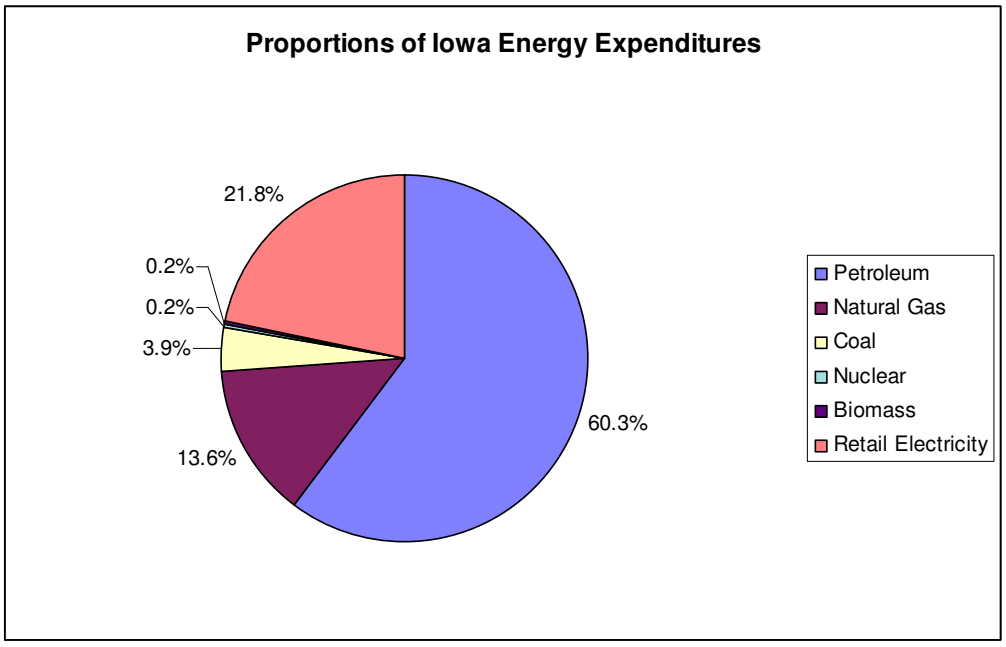
Iowa's energy bill in 2006 was $13.4 billion, the highest expenditure ever recorded until that time. This is a 61% increase from 2000. Graph 25 illustrates Iowa's primary energy expenditure growth between 1980 and 2006. Graph 26 includes the breakdown of Iowa's 2006 energy expenditures by fuel type. Graph 27 tracks Iowa's energy prices by fuel type from 1990 to 2006.

Most of the growth in Iowa's energy expenditures shown in Graph 25 came from sharp increases in fuel prices. Graph 27 shows that, from 2000 to 2006, coal price increased 36 percent ($0.91 to $1.24/MMBtu), natural gas price increased 51 percent ($6.45 to $9.73/MMBtu) while petroleum price increased 73 percent ($10.74 to $18.58/MMBtu). During the same time period, electricity prices increased 18 percent ($17.39 to $20.54/MMBtu).

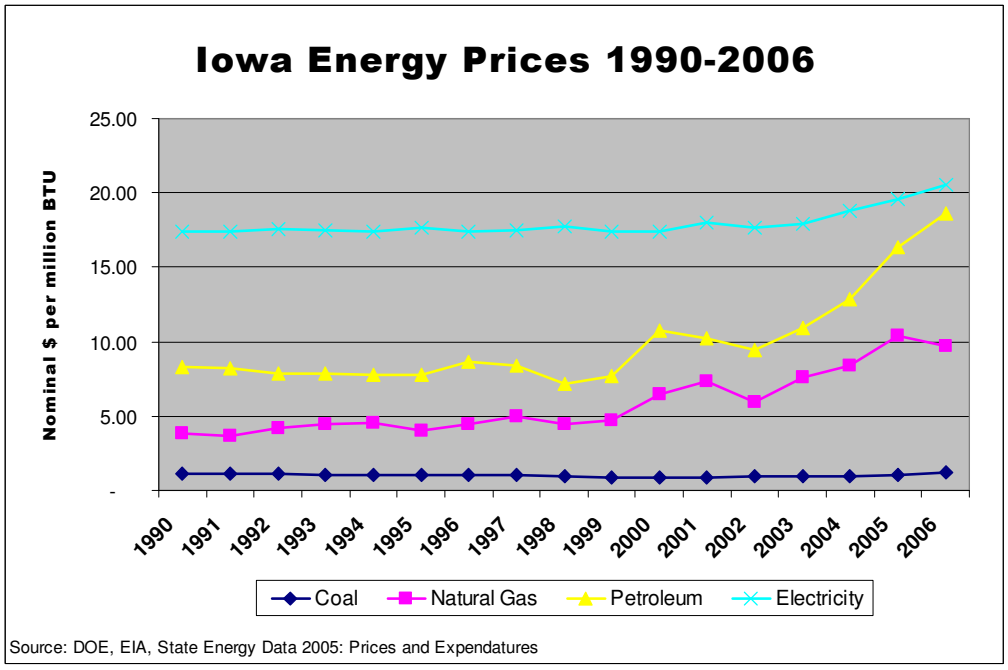
Graph 35: Iowa Total Energy Expenditures, 1980-2006



Graph 36: Proportions of Energy Expenditures – 2006



Graph 37: Energy Price Changes, 1990-2006



Expenditure "Leakages"

More than 94% of Iowa's primary energy sources come from out of state. However, not all of Iowa's energy expenditures on the imported energy sources leak out of state. Iowa State University (ISU) Department of Economics report from December 2005 "Analysis of Energy Supply and Usage in the Iowa Economy" observes that there is considerable economic activity involved in getting primary energy processed, converted and distributed to final consumers and businesses.

Much of this added value is generated within the Iowa economy. The ISU study analyzed energy expenditures and the share of those expenditures that leave the state for three forms of energy: natural gas, petroleum, and electricity. As seen in Table 3, this leakage of expenditures is greatest for natural gas at 52.4%. With electricity, only 17.8 % of total expenditures leak out of state. This lower percentage is due to the fact that most electric generation occurs in Iowa and the distribution functions are all within the state.

Table 3: Energy Leakages in Iowa

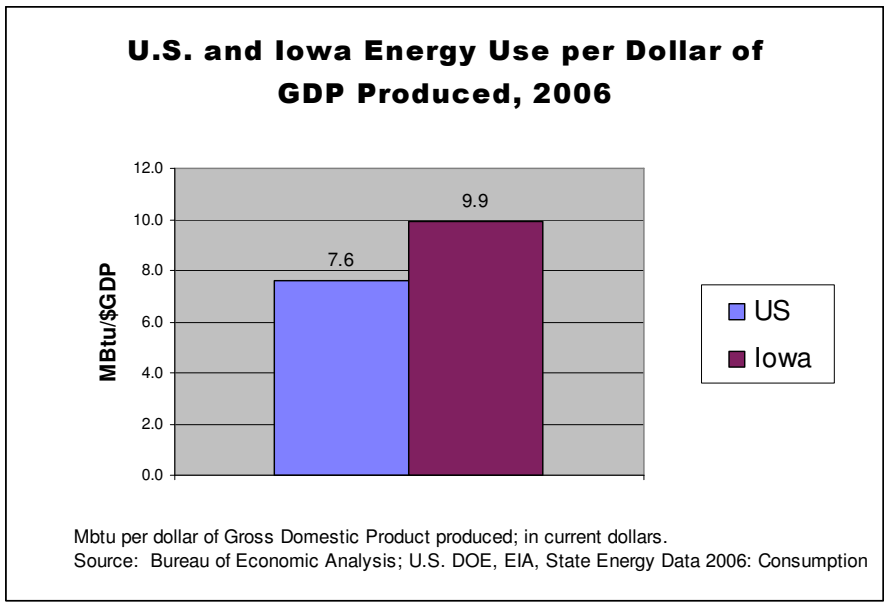
Energy	2001 Expenditure ($ billion)	Leakage (percent)	$ Exported ($ million)
Natural Gas	1.59	52.4 %	834.5
Petroleum	4.08	41.6 %	1,697.3
Electricity	2.41	17.8 %	428.6
Total	8.08	36.6 %	2,960.4

Energy intensity

As indicated in Graph 7 in an earlier part of this report, Iowans use 22% more energy on a per capita basis than the U.S. average. In addition, as illustrated in Graph 38, Iowa's energy consumption per dollar of gross domestic product produced is 30% higher than the U.S. average.

The Iowa Utilities Board sought to analyze Iowa's relatively high energy intensity in a series of documents titled "Per Capita Energy Consumption in Iowa and the U.S." (April 2008). The IUB report explains that energy intensity varies widely among states due to their differing economic, geographic and demographic differences. The IUB developed a State-Level Energy Consumption Analysis model. Based on this model, the IUB concludes that Iowa uses 4% less energy than would be expected based on the state's economic, geographic and demographic characteristics. According to the analysis, Iowa's energy consumption in the commercial and transportation sectors was what would have been expected, but the state's energy consumption in the residential and industrial sectors was significantly less than expected. The IUB report attributes Iowa's high energy density to the significant role manufacturing and agriculture play in the state's economy.

Graph 38:



Mbtu per dollar of Gross Domestic Product produced; in current dollars.
Source: Bureau of Economic Analysis; U.S. DOE, EIA, State Energy Data 2006: Consumption

Economic Impacts of Renewable Energy and Energy Efficiency

The actual economic impact of renewable energy development and energy efficiency can be difficult to determine, but various studies have attempted to analyze those effects. Comparison of results is difficult due to differing focus areas and methodologies of the studies.

A 2006 study by the University of Tennessee attempted to estimate, on the national level, the economic impact of producing 25% of the nation's total energy demand from agriculture and forestry resources by year 2025. The study concluded that the "25 X '25" goal is achievable and can be met without compromising the agricultural sector's ability to reliably produce food, feed and fiber at reasonable prices. According to the study, reaching the goal would have a very favorable impact on rural America and the nation as a whole. Including multiplier effects in the economy, the estimated annual impact on the nation would be more than $700 billion in economic activity and

5.1 million jobs in 2025. Studies in other states also point to positive economic impacts from energy efficiency and renewable energy technologies. A September 2007 study by the American Council for an Energy Efficient Economy concluded that in Texas cost-effective investments in a combination of energy efficiency and renewable energy technologies can reduce overall electricity costs, boost net employment, and reduce air pollutants. According to an accompanying ACEEE study, even in the fastest growing metropolitan areas of Texas, rising electricity needs can be met with energy efficiency and renewable energy.

Biofuels

Iowa is the leading producer of both ethanol and biodiesel. According to the Iowa Renewable Fuels Association, as of December 2008 there were 35 ethanol refineries in Iowa with a total annual production capacity of 2.88 billion gallons. Additional capacity of 880 million gallons was under construction at that time. As of December 2008, Iowa's 14 biodiesel refineries had the capacity to produce 317.5 million gallons annually, with an additional 35 million gallons of capacity under construction. However, it should be noted that year 2008 has been a time of great volatility and uncertainty in the biofuels industry. Not all biofuels refineries have been producing at full capacity due to unfavorable market conditions.

Iowa State University study "Analysis of Energy Supply and Usage in the Iowa Economy" from December 2005 did not calculate the percentage of expenditure leakage out of state for biofuels industry. The analysis model used in the study did indicate that 55 % of ethanol input stream comes from in-state resources. Thus, increased use of ethanol lessens Iowa's energy expenditure leakage. Among the major out-of-state components in ethanol production are the primary fuels – natural gas and coal – that are used to power ethanol plants.

The ISU study from December 2005 analyzed the economic impact on the Iowa economy of exporting 800 million gallons of ethanol annually (Iowa's ethanol export level at the time of the study). According to the study, 800 million gallons of annual ethanol production created 2,402 jobs and generated $2.2 billion in sales and $80 million in household income. A January 2008 report by David Swenson of Iowa State University, "The Economic Impact of Ethanol Production in Iowa," estimated the economic impacts of Iowa's ethanol industry at the end of 2007. Iowa's 27 ethanol plants in operation at that time had the capacity to produce approximately 2 billion gallons of ethanol. Swenson estimated that the 27 plants directly employed 1,242 individuals and the total job impact of the ethanol facilities for Iowa was 5,440 jobs.

Other studies have indicated greater impact from biofuels industry on Iowa's economy. In a study commissioned by Iowa Renewable Fuels Association and published in February 2007, John Urbanchuk of LECG LLC estimated the economic contributions of both ethanol and biodiesel industries in Iowa. The study was based on production capacity levels at the end of 2006. The study estimated that the 1.7 billion gallon ethanol production capacity contributed $7.3 billion to Iowa Gross Domestic Product, supported the creation of 47,000 jobs, generated $1.7 billion in household income, and generated $350 million in state tax revenue. It was estimated that the 115 million gallon biodiesel production capacity contributed $900 million to Iowa GDP, supported the creation of 6,100 jobs, generated $104 million in household income, and generated $36.5 million in state tax revenue.

Authors of the Iowa State University study "Analysis of Energy Supply and Usage in the Iowa Economy" acknowledge that their modeling was unable to account for all market effects of ethanol production and its continued growth. Ethanol industry growth affects many production relationships in broad areas of the economy, such as livestock industry, soybean production and processing, rail and road transportation, and grain warehousing. The sheer quantity of corn needed to supply Iowa's growing ethanol industry is significant. When all of Iowa's approximately 3.5 billion gallon per year ethanol capacity that is currently under construction comes online, the industry is expected to utilize approximately 1.23 billion bushels of corn. (On average, one bushel of corn yields 2.8 gallons of ethanol.) This 1.23 billion bushel demand is approximately 50% of Iowa's estimated total corn crop of 2.4 billion bushels in 2007.

Wind Energy

Over the last few years Iowa has been able to attract several wind industry manufacturing facilities. Clipper Windpower and Acciona Windpower both manufacture wind turbines in Iowa, Siemens Power Generation and TPI Composites manufacture blades for turbines, and Trinity Industries and Hendricks Industries manufacture wind turbine towers. These wind industry manufacturing facilities are expected to employ approximately 2,000 people in Iowa. In addition to manufacturing jobs, Iowans are employed in the wind energy sector by wind turbine installers and wind project developers, owners and operators. There are also many other Iowa companies that provide services and products for wind industry businesses.

The modeling used in the Iowa State University study "Analysis of Energy Supply and Usage in the Iowa Economy" was unable to analyze the economic impacts of wind energy development. However, the authors of the study concluded that, based on the assessment of other energy generating activities, it is likely that wind energy provides greater in-state economic impacts than electric generation that utilizes imported fuel. An increasing proportion of the wind turbines are manufactured in Iowa, and the construction and subsequent operation and maintenance are mostly in-state expenditures.

Effects of energy policies

Two recent studies, by Union of Concerned Scientists and Environment Iowa Research & Policy Center, attempted to estimate economic impacts of more aggressive renewable energy and energy efficiency development in Iowa.

The Environment Iowa Research & Policy Center study "Redirecting Iowa's Energy," published in 2006, estimated the economic and consumer impact of two different energy development strategies. Scenario 1 considered the impact of enacting a 20 % renewable portfolio standard (RPS) by 2020 and funding a publicly-run energy efficiency program at an annual funding level of $50 million from 2007 to 2020. Scenario 2 considered the impact of a 20 % renewable RPS by 2020 and funding a publicly-run energy efficiency program at an annual funding level of $100 million from 2007 to 2020. Of the new jobs created by the two scenarios, more than half occurred in the service sector. The modeling showed strong employment growth also in construction, retail, finance and manufacturing sectors. The economic and consumer impacts of both scenarios are included in Table 4.

Table 4: Economic Impact Summary of Environment Iowa Study

Impact	Scenario 1: 20% RPS, $50M EE	Scenario 2: 20% RPS, $100M EE
Net job increase in 2020 (actual)	2,340	5,166
Net increase in wages in 2020 (2001 dollars)	$31 million	$37 million
Annual electric savings in 2020 (2001 dollars)	$147 million	$440 million

In a 2007 study, Union of Concerned Scientists evaluated the economic impacts of a national 20 % renewable portfolio standard in Iowa. A summary of the impact are seen in Table 5. The projected consumer savings in electricity and natural gas expenditures are attributed to reduced demand for fossil fuels and the creation of new competitors in the energy market. According to the study, renewable energy technologies tend to create more jobs than fossil fuel technologies because a larger share of the expenditures is spent on manufacturing equipment, installation and maintenance. All of these activities are typically more labor intensive than extracting and transporting fossil fuels. Another local economic benefit of renewable energy is the fact that fuel expenditures are not exported out of state, keeping money circulating in the local economy.

Table 5: Economic Impact Summary of UCS Study

Impact	Effect of 20% RPS by 2020
New jobs	2,130
New capital investment	$769 million
Farmer & rural landowner income	$527 million
New local tax revenue	$27 million
Consumer savings in electricity, natural gas (cumulative)	$83 million

Number and composition of renewable energy and energy efficiency jobs

A 2007 study by the American Solar Energy Society and Management Information Services, Inc. evaluated the size and composition of renewable energy and energy efficiency industries in the United States in 2006. Table 15 summarizes findings of the study. The U.S. study indicates that the energy efficiency industry is currently much larger than the renewable energy industry, but the latter is growing more rapidly. Of the more than 8 million jobs in the energy efficiency sector, 98% are in private industry. More than 50% of energy efficiency industry jobs are in the manufacturing sector. Recycling and construction sectors are other significant employers in the energy efficiency industry. In the renewable energy sector, 95% of the jobs are in the private sector. Nearly 70% of the renewable energy jobs are in the biomass sector – primarily in ethanol and biomass power. Wind energy employs the second most people in the renewable energy industry.

Table 6: U.S. Renewable energy and energy efficiency industry employment

Industry	Revenues (billions)	Direct jobs	Direct & indirect jobs created
Renewable energy	$39.2	194,000	446,000
Energy Efficiency	$932.6	3,498,000	8,046,000

At this time there are no accurate estimates of employment figures in the renewable energy and energy efficiency industries in Iowa. This is due to the difficulty of determining and tracking all companies that are involved in these industries. In addition, renewable energy and energy efficiency work is only a portion of the activities of many companies. Determining how many employees of such companies are actually working in the renewable energy and energy efficiency area is difficult. Thus, better tracking systems and survey mechanisms must be developed in order to accurately determine employment numbers for renewable energy and energy efficiency industries in Iowa.

The American Solar Energy Society study also evaluated the composition of a typical 250-employee wind turbine manufacturing company. The study concluded that such a renewable energy facility typically employs a wide range of workers at all educational and skills levels at widely differing earnings levels. The average annual salary at a typical wind turbine manufacturer was estimated at $46,400. The analysis also revealed that the job distribution at a typical renewable energy manufacturing facility appears to differ relatively little from that of a company that manufactures other products. Most of these employees are considered “renewable energy workers” only because the company they work for is manufacturing a renewable energy product.

E. Impact of meeting Iowa's energy needs on the environment of the state, including the impact of energy production and use on greenhouse gas emissions.

Greenhouse gas emissions

Senate File 485 (455B.851) passed by the Iowa Legislature in 2007 and signed into law by Governor Culver creates a greenhouse gas inventory and a greenhouse gas registry for the state. In response the Department’s report “2007 Greenhouse Gas Emissions from Select Iowa Source Categories” was completed and sent to the Governor on August 28, 2008. (http://www.iowadnr.gov/air/prof/ghg/files/2007_Greenhouse_Gas_Inventory.pdf Together with the “Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025” prepared by the Center for Climate Strategies for the Iowa Climate Change Advisory Council, they depict the most comprehensive portrayal of Iowa greenhouse gas emissions created to-date.

The “2007 Greenhouse Gas Emissions from Select Iowa Source Categories” report is a refinement of previous statewide greenhouse gas inventories. It is a “bottom-up” inventory of fossil fuel combustion emissions and of emissions from ethanol fermentation at dry mill ethanol plants.

Greenhouse gas (GHG) emissions from fossil fuel combustion were calculated to be 52.1 million metric tons of CO2 equivalent (MMtCO2e) and 2.33 MMtCO2e from dry mill ethanol plants. In addition, carbon emissions from the ethanol fermentation was responsible for an additional 3.94

MMtCO2e from dry mills and 1.36 MMtCO2e from wet mills (not including another 0.13 MMtCO2e GHG emissions from biomass combustion also reported).

The Department's "2007 Greenhouse Gas Emissions from Select Iowa Source Categories" report references a draft report by the Center for Climate Strategies (CCS). The final form of that draft report is the "Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025". The report, available online at http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm, presents an assessment of the State's greenhouse gas (GHG) emissions and anthropogenic sinks (carbon storage) from 1990 to 2025.

The CCS report shows that Iowa's net GHG emissions were approximately 120 million metric tons (MMt) of gross CO2 emissions in 2005. Iowa's gross GHG emissions are rising more rapidly than the nation overall. From 1990 to 2005 Iowa's gross GHG emissions rose by 23 percent while the national average rose only 16 percent. Net emissions were determined to be 92 MMtCO2e in 2005 with 27 MMtCO2e indicated to be stored in carbon sinks such as forests, agricultural soils and biomass.

The principal source of Iowa's GHG emissions in 2005 were due to electricity consumption (31%) and agriculture (23%). Residential, commercial and industrial (RCI) energy use resulted in 20 percent of Iowa's GHG emissions in 2005. Transportation was responsible for 17 percent of Iowa's GHG emissions.

Iowa's gross GHG emissions are projected to grow to about 148 MMtCO2e by 2025 (assuming "business-as-usual") which is 52 percent above the 1990 level. Electricity consumption is expected to be the biggest contributor to emissions growth in Iowa, followed by transportation, and RCI sectors.

The gross CO2e emissions per capita for Iowa rose from 35 metric tons in 1990 to 40 in 2005. During the same period, national average gross CO2e emissions per capita went from 25 to 24. The CCS study attributes the higher emission rates for Iowa to agriculture sector emissions and Iowa's low population density. Over this time period, economic growth in Iowa exceeded emissions growth resulting in a decline of 24 percent in GHG emissions per unit of state product compared to a national average drop of 26 percent.

Iowa Climate Change Advisory Council will submit a report to the Governor and General Assembly that addresses policies, cost-effective strategies, and multiple scenarios designed to reduce statewide greenhouse gas emissions. The Council's final report is due December 31, 2008.

Other Emissions

The energy sector is a significant contributor to other environmental pollutants besides CO_2. Table 7 details emission estimates for sulfur dioxide (SO_2) and nitrogen oxide (NO_X) from Iowa's electric power industry in 1990, 2000 and 2006 as reported by the U.S. DOE. The vast majority of emissions for both pollutants come from coal-fired electric generation. Even though electric generation from coal increased by 34% between 1990 and 2006, emissions of both SO_2 and NO_X have decreased significantly. Between 1990 and 2006, emissions of SO_2 decreased by 28% and NO_X by 60%. These reductions can be attributed to better emissions controls at Iowa's coal-fired

generating facilities. SO_2 is a primary component of fine particulate matter, or "soot." Fine particulates have been tied to respiratory problems and cause unhealthy air advisories in Iowa. NO_X, when reacting with volatile organic compounds in sunlight, forms ground-level ozone, or "smog." Ground-level ozone causes respiratory problems.

Table 7: Electric Power Industry Emissions Estimate 1990, 2000, 2006

Emission Type / Fuel	1990 (thousand metric tons)	2000 (thousand metric tons)	2006 (thousand metric tons)
Sulfur Dioxide (SO_2)			
Coal	182	148	131
Petroleum	*	1	1
Natural Gas	*	*	*
Other	*	*	*
Total	183	149	132
Nitrogen Oxide (NO_X)			
Coal	151	85	61
Petroleum	*	*	1
Natural Gas	1	1	1
Other	*	*	1
Total	152	87	64

* Value is less than 0.5

Mercury is another pollutant tied to the energy-sector. According to U.S. Environmental Protection Agency, more than 40% of all mercury emissions in the U.S. come from coal-fired power plants. Mercury accumulates in the tissue of fish and other aquatic animals and persists in the environment. It can cause serious neurological damage to developing fetuses, infants and children even at low levels.

In addition to the potentially devastating radiation effects of an accident at a nuclear power plant, the highly radioactive waste generated by nuclear power facilities poses a serious environmental threat. The Duane Arnold nuclear reactor in Iowa is expected to have produced 467 metric tons of high-level radioactive waste by 2011, but no permanent storage facility for this waste exists.

Impacts of Renewable Energy Production

While utilizing renewable resources for energy production has many environmental benefits, renewable energy is not without impacts on the natural resources of the state.

Environmental costs and benefits of biofuels have been widely debated. This is the case for corn-based ethanol in particular. The production of corn itself has significant environmental impacts, including soil erosion from intensive row-crop farming, nutrient loading from fertilizer, and contamination of water and soil from pesticide use. Increased corn acreage to supply Iowa's

growing ethanol industry may exacerbate these problems. Ethanol facilities themselves often discharge sediment- and nutrient-rich water into Iowa's water bodies. An additional concern is the effect of ethanol industry on water quantity. Until now, water quantity has not been a serious issue in Iowa. However, fast growing biofuels industry appears to have the potential to significantly impact water supplies at the local level.

Biofuel refineries are most often fueled by natural gas and coal, which generate carbon dioxide and other air pollutants such as NOx, SO_2 and mercury. Due to significant fossil fuel inputs in corn production and at ethanol facilities, U.S. Department of Energy estimates that the use of corn-based ethanol can reduce overall greenhouse gas emissions only by 18-28 % compared to gasoline. Cellulosic ethanol is estimated to reduce GHG emissions by 87 %.

Recently, much attention has been paid to the effects of indirect land use changes on the "carbon footprint" of biofuels produced from corn and other food crops. At the heart of this discussion is the idea that when corn and other food crops are utilized for biofuels production, crop production in other parts of the world will be increased to make up for the crops diverted to fuel production. This increased cropping around the world will cause land use changes and cause increased greenhouse gas emissions. If and how these greenhouse gas emission changes will be attributed to biofuels production will have a significant impact on the carbon footprint of biofuels production.

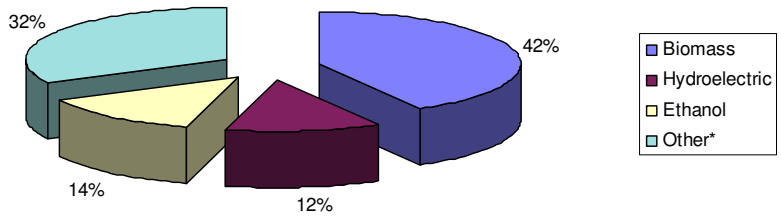
The most controversial environmental issue regarding wind energy has been the impact of wind turbines on bird populations. Most of the controversy stems from an early wind farm in California that experienced high levels of avian mortality. Studies in other areas, including Iowa, have not shown significant impacts on avian populations. It is standard practice for wind farm developers to conduct avian impact studies to avoid areas that pose a risk for significant avian impacts. Another area of concern has been the impact of wind turbines on bats. An Iowa State University study on bird and bat mortality associated with the Top of Iowa Wind Farm from August 2002 to August 2005 found minimal impact on birds in the region, but bat mortality was found to be "substantial." Study authors recommended that more research should be conducted on bat behavior and mortality at wind farms. "Visual pollution" from wind turbines is mostly a question of esthetics, and it has not come up as a serious problem in Iowa.

F. Evaluation of renewable energy sources, including the current and future technological potential for such sources.

Graph 39 contains a breakdown of Iowa's renewable energy consumption in 2006. Graph 31 in an earlier section of this report illustrates the development of renewable energy consumption for years 1995-2006. In 2006, 42% of Iowa's renewable energy consumption came from biomass. Hydroelectric energy makes up 12% of Iowa's renewable energy consumption and ethanol 14%. The category "other" renewable energy has been growing very rapidly in the last few years, reaching 32% of all renewable energy consumption in 2006. In Iowa, the category of "other" renewable energy comprises mainly of wind energy.

Graph 39:

Composition of Iowa Renwable Energy Consumption, 2006



Source: U.S. DOE, EIA, State Energy Data 2006: Consumption.
*"Other" category includes wind, solar and geothermal energy.

Biomass

Biomass is the most consumed form of renewable energy in Iowa, comprising 42% of Iowa's renewable energy consumption in 2006. Industrial sector accounted for 74 % of the total biomass consumption in 2006. Use of biomass is at a significantly lower level than in the 1980's and most of 1990's. In the late 1990's biomass consumption declined rapidly, but consumption levels have been relatively constant since 2000. The development of second-generation biofuels will likely increase the utilization of Iowa's biomass resources. Development of cropping, harvesting, storage and transportation systems for cellulosic feedstocks will benefit both biofuels and biopower industries. It is likely that public policies affecting the utilization of biomass will have a significant impact on future development and use of biomass technologies in the state.

Hydro

Iowa's hydroelectric capacity was 131 MW in 2006. Due to minimal changes in Iowa's hydroelectric capacity, its use in the state has remained relatively stable for many years. Potential to significantly increase Iowa's hydroelectric capacity is limited.

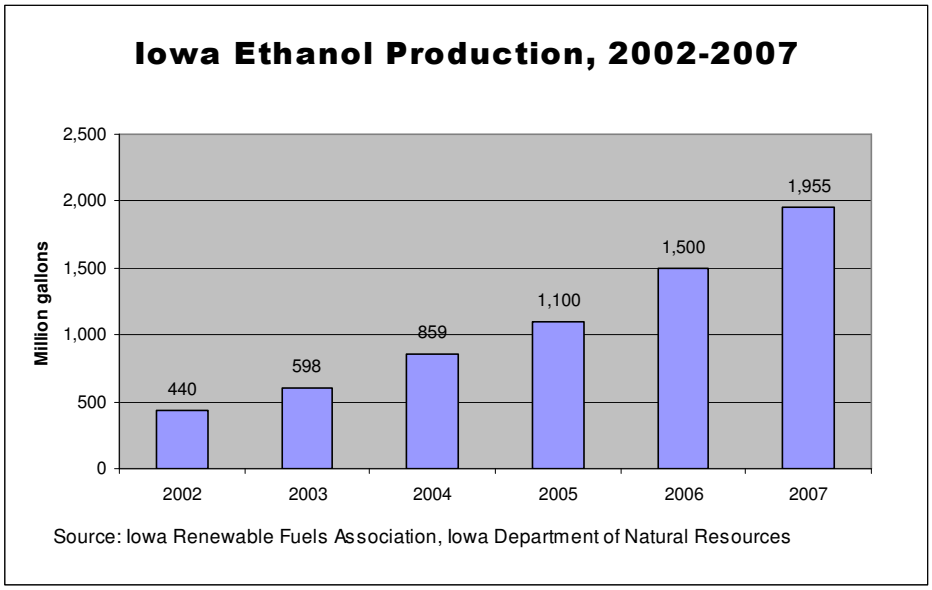
Biofuels

Iowa is the leading producer of both ethanol and biodiesel in the nation. Table 8 includes Iowa's current production capacity and capacity under construction for both ethanol and biodiesel. The data is based on figures provided by the Iowa Renewable Fuels Association as of December 2008. Graphs 40 and 41 include ethanol and biodiesel production information for Iowa. Iowa is a net exporter of both ethanol and biodiesel. Based on information from the U.S. Department of Energy, Energy Information Administration, approximately 118 million gallons of ethanol was consumed in Iowa in 2006. No comparable consumption data for biodiesel is available.

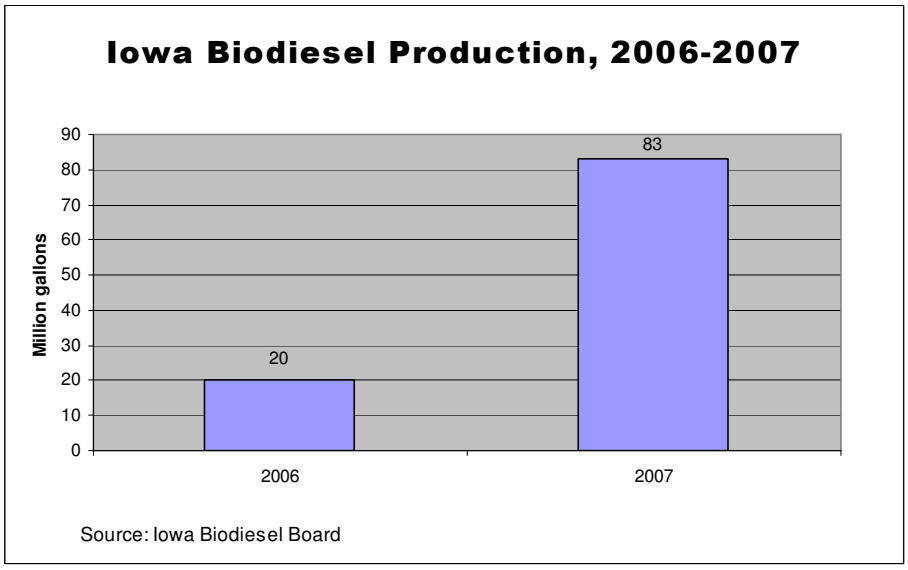
Table 8: Iowa Ethanol and Biodiesel Capacity, December 2008

Fuel	Current Capacity (million gallons)	Under Construction (million gallons)
Ethanol	2,879	880
Biodiesel	317.5	35

Graph 40:



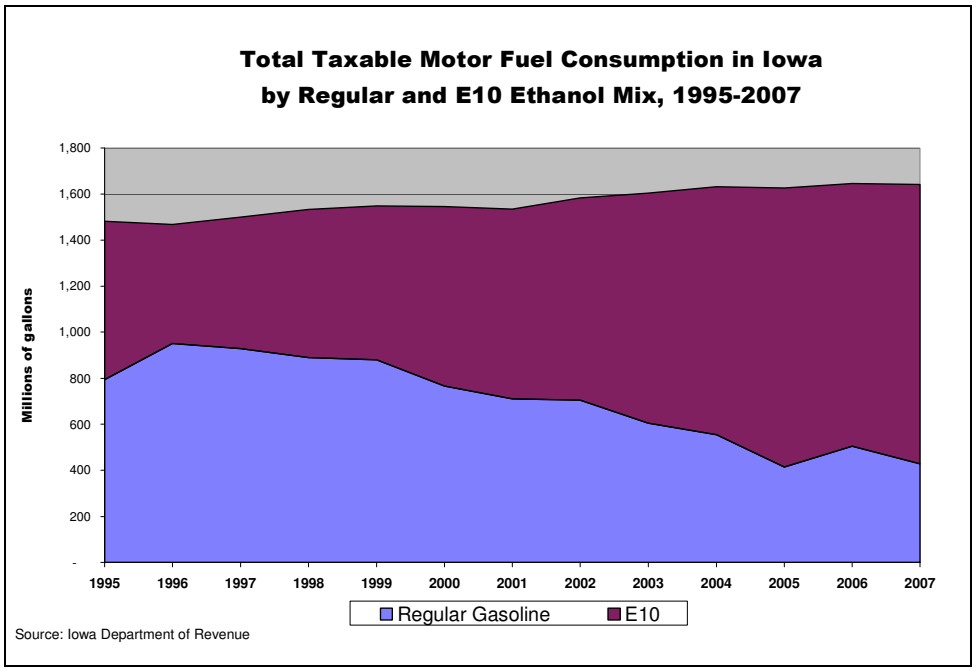
Graph 41:



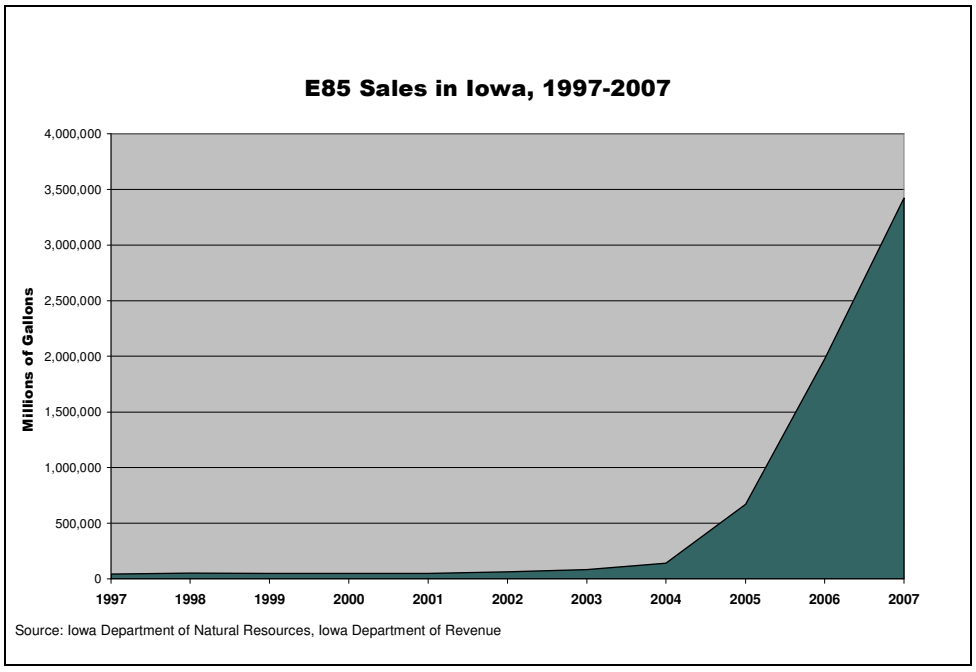
Ethanol is sold in Iowa as a 10 % blend (E10) and 85 % blend (E85). Retail sales of ethanol blended gasoline have increased steadily over the last several years, as illustrated in Graphs 42 and 43. Sales of E85 blend have skyrocketed in the last few years, from approximately 140,000 gallons in 2004 to 3.4 million gallons in 2007. This rapid growth can be attributed to increased

availability of the fuel due to more numerous retail outlets offering the product. Despite this growth in sales, in 2007 E85 blend accounted for only 0.1 % of all gasoline retail sales in Iowa (Graph 44).

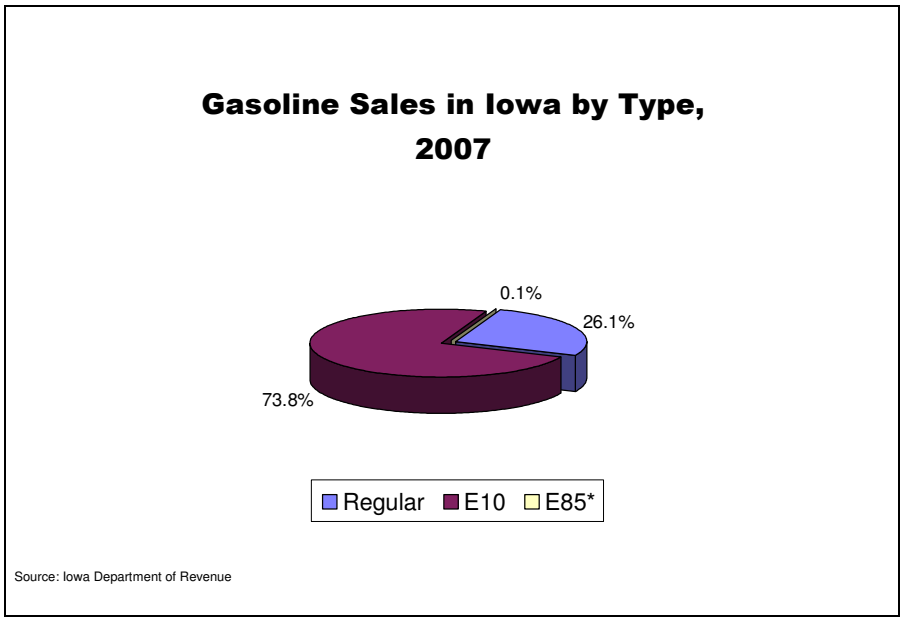
Graph 42:



Graph 43:



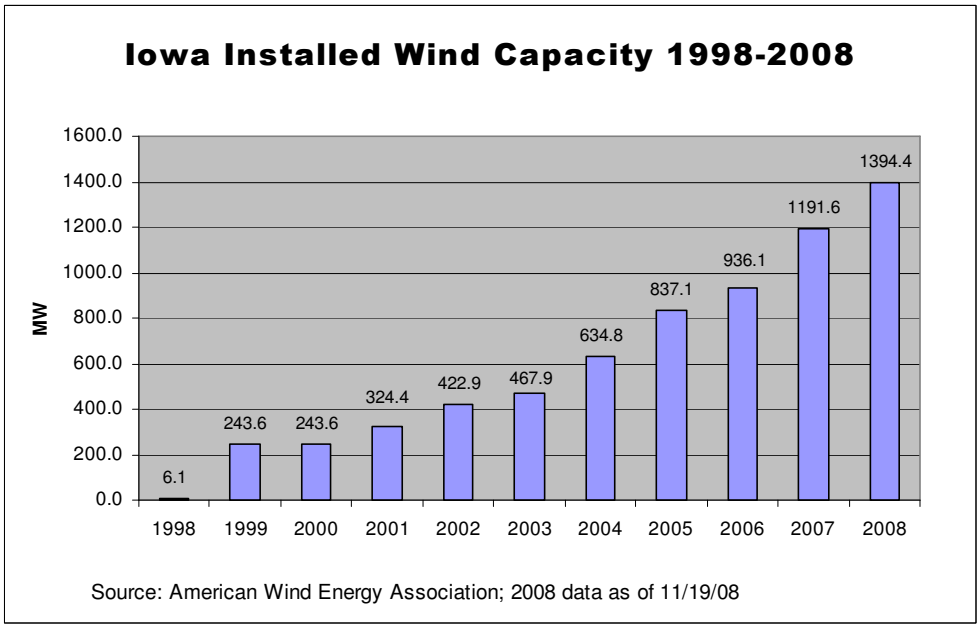
Graph 44:



Wind Energy

As of November 2008, Iowa had 1,394 MW of installed nameplate capacity of wind energy. This ranked Iowa third among all states, trailing only the much larger states of Texas and California. Graph 45 details the rapid expansion of wind energy capacity in Iowa since the late 1990's. Most of Iowa's existing wind energy capacity has been developed by large investor-owned utilities and out-of-state wind energy developers. Rapid growth in wind energy is expected to continue in Iowa. According to the American Wind Energy Association, 1,480 MW of wind energy capacity was under construction in Iowa as of November 2008.

Graph 45:



Renewable Energy Potential

As required by the Iowa Legislature, the Iowa Utility Association, Iowa Association of Electric Cooperatives and Iowa Association of Municipal Utilities commissioned a study to examine Iowa's renewable energy production potential. "Renewable Energy Cost Effective Potential Study" was prepared by Black & Veatch Corporation and delivered to the Iowa Office of Energy Independence on December 1, 2008.

According to the Black & Veatch study, the least-cost sources of renewable energy for electric generation in Iowa include approximately 84 GWh of landfill gas generation, 1,400 GWh of biomass cofiring at existing coal-fueled generators, and up to 32,000 GWh of wind generation. Additional resources are available, but at a much higher cost. To put this renewable energy potential in perspective, Iowa's total electric net generation in 2007 was approximately 49,700 GWh. The Black & Veatch study concludes that Iowa's current transmission infrastructure is inadequate to support the renewable potential in Iowa. Significant investment in transmission infrastructure is needed to support new renewable generation.

The findings of the Black & Veatch study are in line with "Iowa Renewable Resource Assessment" report by the U.S. DOE National Renewable Energy Laboratory (NREL) from September 2005. According to the NREL report, Iowa has the technical potential to develop from 14,000 MW to 165,000 MW of renewable energy capacity. The NREL report concludes that, in light of resource availability and cost, Iowa has the greatest potential to develop wind and biomass resources. While landfill gas generators are among the lowest cost renewables, there are limited resources to develop in Iowa. There is ample solar resource to support significant levels of solar photovoltaic energy on existing rooftops, but at a higher cost than the other renewables.

Reference List:

American Council for an Energy-Efficient Economy, “Role of Energy Efficiency and Onsite Renewables in Meeting Energy and Environmental Needs in the Dallas/Fort Worth and Houston/Galveston Metro Areas,” September 2007 (http://aceee.org/pubs/e078.pdf)

American Council for an Energy-Efficient Economy, “The Economic Benefits of an Energy Efficiency and Onsite Renewable Energy Strategy to Meet Growing Electricity Needs in Texas,” September 2007 (http://aceee.org/pubs/e076.pdf)

Bedzek, Roger H., Management Information Services, Inc., “Economic and Jobs Impacts of the Renewable Energy and Energy Efficiency Industries: U.S. and Ohio,” July 2007 (http://www.ases.org/jobs_report.pdf)

Black & Veatch Corporation, “Renewable Energy Cost Effective Potential Study,” December 1, 2008

Center for Climate Strategies, “Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025,” October 2008 (http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm)

Environment Iowa Research & Policy Center: “Redirecting Iowa’s Energy,” 2006 (http://www.uspirg.org/uploads/tl/zy/tIzyfu9jHWqyL5dwI52ZHQ/Redirecting_Iowas_Energy.pdf)

Iowa Department of Natural Resources, “2007 Greenhouse Gas Emissions from Select Iowa Source Categories,” August 2008 (http://www.iowadnr.gov/air/prof/ghg/files/2007_Greenhouse_Gas_Inventory.pdf)

Iowa Renewable Fuels Association website, December 2008. Ethanol facility information: http://www.iowarfa.org/ethanol_refineries.php Biodiesel facility information: http://www.iowarfa.org/biodiesel_refineries.php

Iowa State University, Department of Economics: “Analysis of Energy Supply and Usage in the Iowa Economy,” December 2005 (http://www.iowadnr.com/energy/info/files/economy.pdf)

Iowa Utilities Board, “An IUB Staff Analysis: Per Capita Energy Consumption in Iowa and the U.S.,” April 2008

Koford, Rolf R., Jain, Aaftab, “Bird and Bat Mortality Associated with the Top of Iowa Wind Farm,” August 2005, (http://www.ag.iastate.edu/centers/cfwru/projects/completed/WindFarm2005.pdf)

Swenson, David, Iowa State University, Department of Economics, “The Economic Impact of Ethanol Production in Iowa,” January 2008 (http://www.econ.iastate.edu/research/webpapers/paper_12865.pdf)

Union of Concerned Scientists, “Cashing In on Clean Energy,” 2007 (http://www.ucsusa.org/clean_energy/clean_energy_policies/cashing-in.html)

University of Northern Iowa, Center for Energy and Environmental Education, “Year 2000 Iowa Greenhouse Gas Emissions Inventory,” January 2005 (http://www.iowadnr.com/energy/news/files/greenhouse.pdf)

University of Tennessee, Department of Agricultural Economics, “25% Renewable Energy for the United States By 2025: Agricultural and Economic Impacts,” November 2006

(http://www.agpolicy.org/ppap/REPORT%2025x25.pdf)

Urbanchuk, John M., LECG LLC: “Contribution of the Biofuels Industry to the Economy of Iowa,” February 2007 (http://www.iowarfa.org/PDF/2006%20Iowa%20Biofuels%20Economic%20Impact.pdf)

U.S. Department of Commerce, Bureau of Economic Analysis, “Interactive Tables: Gross Domestic Product by State” (http://www.bea.gov/regional/index.htm)

U.S. Department of Energy, Energy Information Agency: “State Energy Data 2006: Consumption” (http://www.eia.doe.gov/emeu/states/sep_use/total/pdf/use_ia.pdf)

U.S. Department of Energy, Energy Information Agency: “State Electricity Profiles 2006, Iowa” (http://www.eia.doe.gov/cneaf/electricity/st_profiles/iowa.html)

U.S. Department of Energy, National Renewable Energy Laboratory, “Iowa Renewable Resource Assessment,” September 2005